



**POLITECNICO
DI TORINO**

Dipartimento di
Architettura e Design

ANZALI WATERSHED

Systemic approach applied in Gilan province in north of Iran

Thesis for Master of Science Degree in Ecodesign

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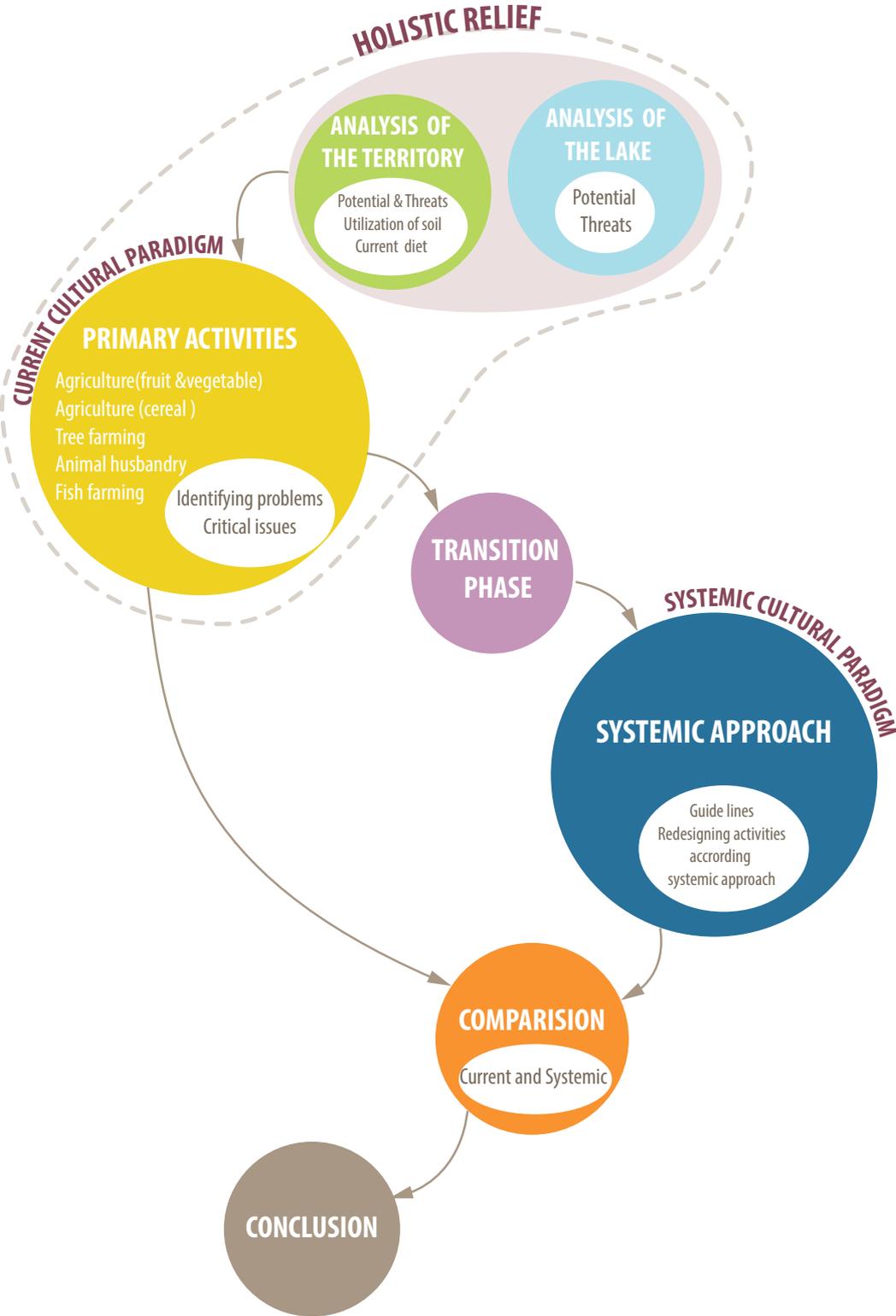
CANDIDATE Shabnam Sharifi

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INTRODUCTION

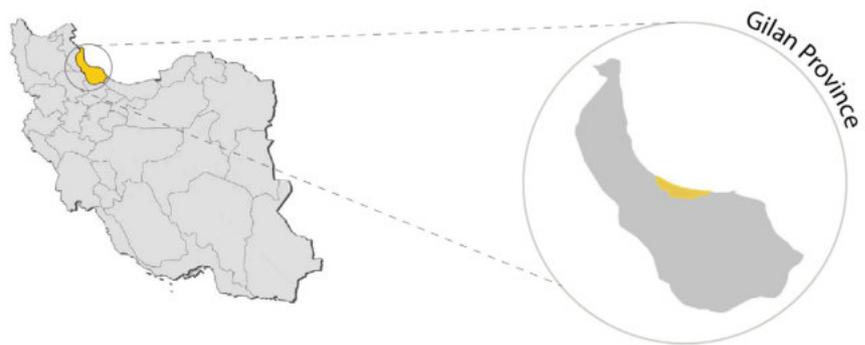
Anzali is one of the northern cities of Iran , located in Gilan province ,which has been on of the most important economical and tourism area of Iran thanks to its valuable features and attractions including Anzali port ,Anzali wetland.

Unfortunately , this area has faced so many problems in the last decades; From economical view ,even though it has Anzali port, Free zone, fishery and abundant fertile lands , but still people are not in a proper situation and statistics show a high level unemployment crisis. From social view , although it benefits from proper climate and plenty of food resources , but still its residents live in an unacceptable situation of health and the city has be declared as one of the worst cities of Iran in health situation .Finally from environment aspect , lots of natural sources in this region are in charge of depletion ,from which we can notice Anzali wetland degradation . This wetland plays an important role in Anzali `s tourist attraction and its drying up has costed extinction of so many species.

From the above , the aim of this project is to determining the opportunities given by the territory to develop a systemic situation that contributes the economic , social and environmental improvement in the region .

In this project , as the first step a holistic research has been realized in order to identify and define the strengths and weakness of the current situation on Anzali territory and the surrounding area of Anzali wetland , as the next step eating food pattern of natives has studied and the most important activities related to food have been considered ; Later on , each of these activities have been analyzed and discussed one by one . After all , considering guidelines of systemic approach each and every of these activities has been reprogrammed.

Gilan Province is one of the northern provinces of Iran. It lies along the Caspian sea with an area of 14,042 km² and a population of 2,410,523 inhabitants. At the center of the province is the main city of Rasht which is known internationally as the “City of Silver Rains” and in Iran as the “City of Rain”.



Archaeological excavations reveal the antiquity of the province to date back to prior to the last Ice Age.



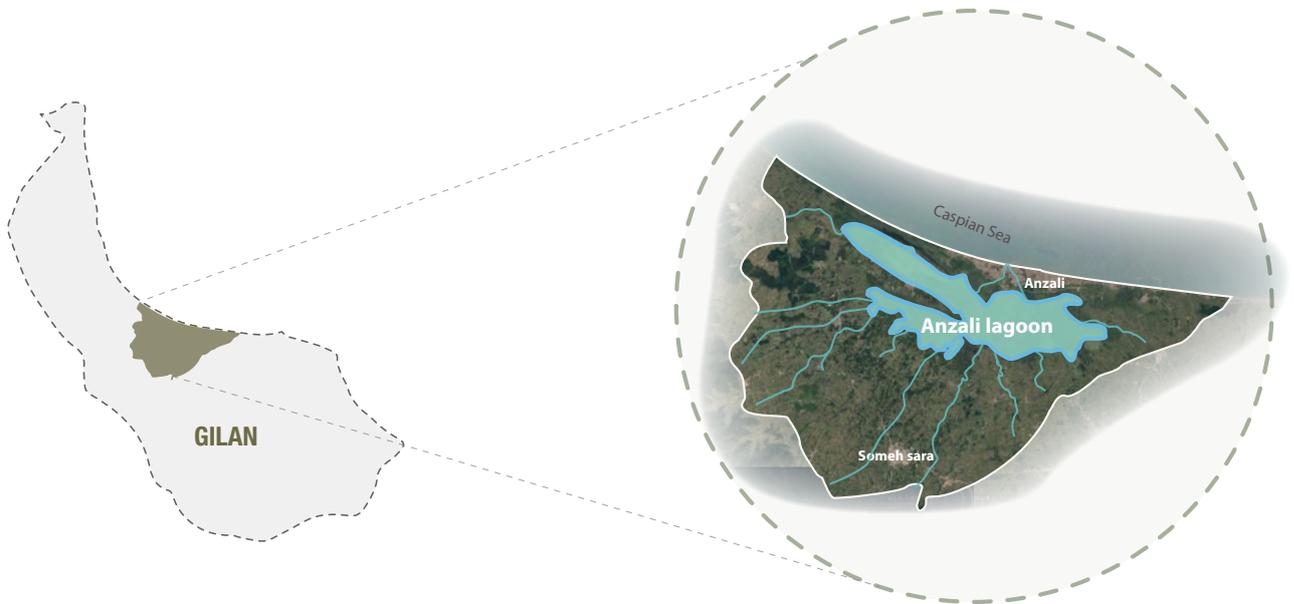
Gilan has a humid subtropical climate with the heaviest rainfall in Iran. The Alborz range provides further diversity to the land in addition to the Caspian coasts, Large parts of the province are mountainous, green and forested. The coastal plain along the Caspian Sea mainly used for rice paddies.



Anzali Lagoon that is one of the most interesting and greatest natural habitats of fauna in Iran, is located in the center of Gilan province. Due to its geographical position and in terms of its high humidity and water, it is not comparable to any other lagoons in Iran.

ANALYZED ZONE

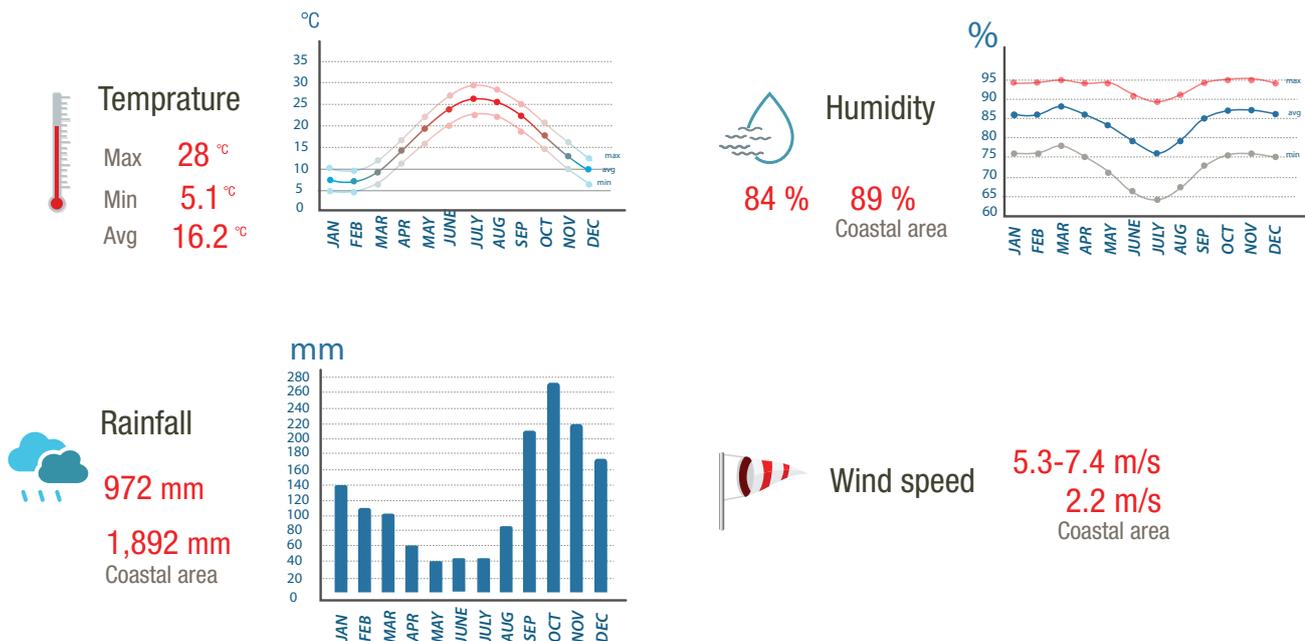
In this project, a part of anzali watershed with an area of 90,100 ha in the center of Gilan province has been selected and Anzali city and the surrounding area of anzali wetland has been analyzed.



Anzali is the second most populated city in Gilan Province and the first and largest port on the southern shores of the Caspian Sea. For centuries Anzali has served as a gateway to Europe, connecting the economies of the East and West. Not surprisingly the customs authority of Anzali is at least 300 years old. Fishing is the main occupation in Anzali, which is the main producer of caviar in Iran. Rice cultivation and farming are the other traditional professions of Anzali inhabitants.

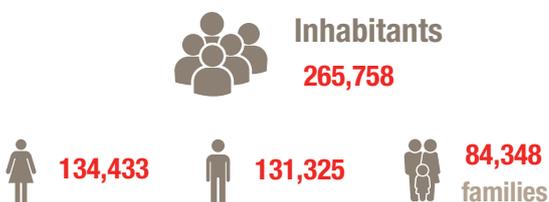
CLIMATE

Due to being adjacent to the Caspian Sea, this district has a humid subtropical climate with high levels of annual rainfall even in the driest months. Humidity levels vary between 84 to 89 percent and the average of its temperature is nearly 16 degree centigrade. The dry season in this area does not last for a long time during the year (about one month in June- July) and it often rains.



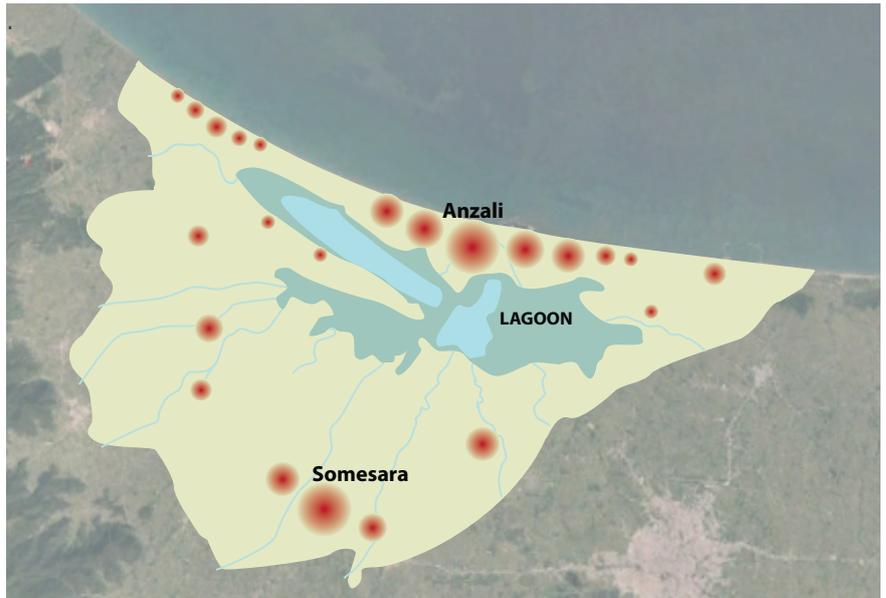
POPULATION

According to the Statistical Centre of Iran, the total population of this area is around 265,758, from which 168,701 live in cities and 97,057 are villagers.



Numerous factors such as favorable climate, moist and fertile soil, the existence of permanent current water networks, abundant and various agricultural facilities and well-extended connection roads cause the intense density of population in this area.

The map on the next page illustrates population distribution in this area :



LANGUAGES

The Gilaki language is spoken in Gilan Province. It is a Caspian language and a member of the northwestern Iranian language branch. The Talysh and Azerbaijani languages are also spoken in the province. Persian is also spoken as it is Iran's official's language.

RELIGIONS



Around 90–95% of locals associate themselves with the Shia branch of Islam, the official state religion, and about 5–10% with the Sunni and Sufi branches of Islam. The remaining 0.6% associate themselves with non-Islamic religious minorities, including Bahayi, Mandeans, Yarsanis, Zoroastrians, Jews, and Christians.

ARCHITECTURE

Archaeological excavations reveal the antiquity of the province to date back to prior to the last Ice Age. However, due to high humidity, there are only a few historical sites in this part. The growth of plants over monuments and historic buildings is one of the major problems that lead to wearing out the buildings.

During the last decades, many archaeological sites have been identified and added to the National Register of Historic Places. Some have clear records of their history, but most of them have lack of reliable, primary document because they have been repeatedly repaired and rebuilt throughout their history and the only way is to rely on a variety of indirect evidence such as the dates engraved on entrance doors or on tombstones.

THE BRICK MINARET OF GASKAR

The brick minaret of Gaskar, apparently dating from the Safavid period (1501-1736 AD). The height of the minaret is 29 meters and its diameter is 7 meters and in the upper part is 2.35 meters

The main purpose of the construction is not clear but it was probably used to determine the exact time of sunrise and sunset.



HAFT DAGHNAN BURIED CITY

This historical buried city of haft daghnan was formed during the Safavid era (1502-1736 AD) based on urban models. Based on excavations, the city is the largest remaining city of the Islamic period in the northern Iran. Several industrial, residential, and trade centers including the remains of kilns, glass blowing, blacksmith, and pottery workshops, as well as a large number of coins and stamps, have been discovered in this historical city. Archaeologists believe that the spread of a disease, most probably cholera in the city might have resulted in the death of a large number of people and the migration of the rest to another place and the abandonment of the city.



GHAZIAN BRIDGE

Ghazian bridge was a moveable bridge that was build between 1935 to 1939. During its time, it was one of the few bridges of the advanced world, and has been registered as one of the historical bridges of Iran. The bridge is not moving anymore since the second half of the 30th century.

The length of the Ghazian Bridge is 210 m and 10 m wide and 6.58 m high



GURAB TOLUM BRIDGE

It is one of the historical bridge from the Qajar era (1785 to 1925 AD).



ANZALI CLOCK TOWER

This tower was built in 1815 as a navigational aid for sailors and help guide them safely to port. This brick tower is 28 meters tall and until 1929 always had a light burning at the top. In this year the Anzali municipality decided to change the tower's function from lighthouse to clock tower and installed a four-faced clock on it. In 1991, the municipality of Anzali removed the old clock and replaced it with an electronic one. In 1977 the Anzali tower was registered as one of Gilan's national heritage sites.



MIAN POSHTEH PALACE



This palace was constructed under the orders of the Pahlavi dynasty between 1930 and 1932. On its ceilings and walls are skillful effects of plaster and embossed works. All rooms have a fireplace and windows open to the Caspian Sea in the northern part of the structure and a lush garden in the southern part. After a series of renovations, the palace was turned into a Military Museum in 1989. There are light weapons and military equipment from the Zand (1785-1925) to the Reza Shah Pahlavi eras.

KASMA PUBLIC BATH



This public bath was built in the late Qajar era (1785 to 1925). The bathroom had two hot and cold water pots; It was supplied with qanat or rivers. Unfortunately, this bathroom has been abandoned and unused.

TRADITIONAL HOUSE

The framework for the traditional houses, including foundations, wall studs and roof frame were made of wood. Daub played an ancillary part, for filling in the gaps of timber framing, daub was mixed with chopped rice straw or with the smoother and more homogeneous husks of rice. This type of architecture carried out best results in front of the earthquake, Flood and moisture in last centuries. The buildings were raised above the ground to insulate the living space from the damp soil. The roof, hipped or pointed had four sloping sides and rests mainly on rows of posts, delineating a veranda on the facade. Among other notable features of the local lifestyle, rooms were not differentiated according to gender; they were used differently according to the season. The passage from the cold to the hot season was the occasion of a migration of the household from below to above, and from the inside to the outside.



Recent developments have deeply affected building materials and techniques as well as the organization of space. Cinderblock construction has replaced timber for wall construction, galvanized iron has replaced straw and rush as a roof covering, and the saddle roof has replaced pointed and hipped roofs. Building operations are no longer in the hands of the traditional specialist. Rooms are more specialized; the seasonal shifts within the domestic space are now more limited, and the sense of privacy is emphasized.



KANDUJ & TELEMBAR

Kanduj was a traditional storehouse. They were an efficient means of storage for rice because they protected the products from pests, high humidity, torrential rain, Mice and birds.

It was made up of two meters above ground level. The main structure was made of straw, wood, timber. The ceiling was usually made from rice stem or a wetland plant called galli. The pyramid shape led to a reduction in the intensity of the rain and prevents the penetration of rain into the slopes. At the top of the slope, a gum was placed. So the water could not in any way penetrate the slopes. Today in some rural areas, it is possible to see these structures.



Similarly, the telembar was the location for the first step in curing tobacco and silkworm nurseries.



FOLK COSTUME

Worn with long shirts and matching vests, floor-sweeping skirts with colorful horizontal stripes at the bottom are the discerning feature of the traditional Gilak wardrobe in the northern Gilan province.



ARTISANAL HANDICRAFT

At every point in Gilan province, the residents have produced beautiful and consumable works according to the culture and materials in their city which is an expression of Gilani's culture and art and insight.

Lack of infrastructure and communication facilities, lack of skilled labor, competitive market due to the import of handicrafts from other countries and less interest of young people in craft industry could be the most important threats that handicrafts in this area are faced with.

RASHTI DOOZI (CROCHETING ON FABRIC)



It is an original art of women in the north of Iran which is decorating broadcloth by sewing patterns on it with naturally dyed silk thread using a hook. Creating patterns of crochet is usually subjective based on the artist's taste and is passed on from one generation to the other.

Researchers believe that the history of Rashti doozi back to the 320 BC to 550 BC (Achaemenid period).

HASIRBAFI



Mat weaving is the art of weaving or plaiting strips of organic fibers Sedges which are on the sidelines of the swamps and ponds. That is used for products, such as bedsteads, hats, wicker tables, basket types, container types, and more.

KILIM



A kilim is a flat tapestry-woven carpet or rug. Kilim can be purely decorative or can function as prayer rugs.

CHAMOSH DOOZI



Chamosh is a kind of old-fashioned footwear that is made from the tanned skin of cattle and has no heels. The main feature of this footwear is that Keeping the feet cool during the heat and keeping feet warm when it is cold It has Certificate of authenticity from the UNESCO and it is registered in the National Cultural Heritage List.

Chamosh was often made up of simple, colorless leather, but if they wanted to paint the leather, they used natural color like pomegranate peel.

Today only a few people are concerned about this art and these master crafts could go extinct.

FELT

Felt is a textile material that is produced by matting, condensing and pressing fibers together. Felt can be made of natural fibers such as wool or animal fur, or from synthetic fibers.



CHADOR DOZI

Chador dozi is weaving traditional textile from natural silk and cotton, it is used for curtains and bedsheets and quilted fabrics, and local women close their waist to prevent moisture penetration.

The tents are usually 2 in 2 meters with a red background with the checked pattern and geometric, vegetable and animal designs.



BROOM MAKING

Broom is a cleaning tool consisting of usually organic fibers. It is traditionally made from rice stem or wetland plants.



CALABASH

One of the special handicrafts of this area is calabash, which is painting on pumpkins. It is used for making hookah or base of lights.



FEST



Like in any other cultures, since very ancient times, people in this region have also had special occasions to celebrate and revive traditions. The folklore of Gilan is a striking example of the intricate ties between pre-Islamic practices and Islamic rituals.

As elsewhere in Iran, two calendars govern the annual cycle: a solar calendar marks the dates of the main holiday activities and celebrations, and a lunar calendar regulates the religious year.

The most commonly celebrated feasts, at present, are briefly introduced here:

NOWRUZ



Nowruz is the traditional Iranian festival of spring which starts at the exact moment of the vernal equinox, commencing the start of the spring. It is considered as the start of the New Year among Iranians. Typically, on the first day of Nowruz, family members gather around the table, with the Haft Seen on the table or set next to it, and await the exact moment of the arrival of the spring. At that time gifts are exchanged. Later in the day, on the very first day, the first house visits are paid to the most senior family members.

CHARSHANBE SORI



Ceremonies on the eve of the last Wednesday of the month of Esfand open the New Year's festivities. In the evening, one or more bonfires are started, the number of which must be odd in order to attract good luck. Depending on the area of Gilan, rice straw, or bushes are piled up, as well as old brooms, symbols of the outgoing year.

NOWRUZ KHANI



It is one of the strongest and most popular traditions of this district. About fifteen days before spring arrives, groups of singers are formed, and they go from house to house. In return, it is customary for the householders to give them gifts or to offer them sweets, candies, eggs, peas, and other foods.

ASHURA



Tasua and Ashura are days of mourning in Shia Islam to commemorate the martyrdom of Imam Hussein, a grandson of the Prophet Mohammed. For the duration of the remembrance, it is customary for mosques and some people to provide free meals (nazri) on certain nights of the month to all people. These meals are viewed as being special and holy.

HARVEST FESTIVAL

A harvest festival is an annual celebration that occurs around the time of the main harvest of a given region. Harvest festivals typically feature feasting, both family and public, with foods that are drawn from crops that come to maturity around the time of the festival. Ample food and freedom from the necessity to work in the fields are two central features of harvest festivals.

Rice harvest festival is the most important harvest festival in this district.



FOLK GAMES

Four games, more or less spectacular, are predominant in Gilan and emblematic of the regional identity. morgana jang (egg wars), lafenbazi (tightrope walking), koshti gila-mardi (Gilani wrestling) and varza jang.

The first one is associated with the cycle of Nowruz. The other three are displays that bring together large audiences in specific places or in the courtyard of a house on the occasion of a marriage, a circumcision or the visit of a distinguished guest.



AROS BARAN

Also known as Tabagh Baran ceremony is a few days before the wedding, presents from the bride's family are taken over to the groom's house. women from the groom's family dressed up in festive costumes carry the presents on elaborately decorated large flat containers carried on their heads.



FOOD

Gilan has a strong culinary tradition, from which several dishes have come to be adopted across Iran. It is the first Iranian province in terms of variety of local food in Iran, more than 170 local food are cooked in this province. Rasht, the capital city of Gilan Province, has made it into UNESCO's Creative Cities Network for its gastronomy.

This richness derives in part from the climate, which allows for a wide variety of fruit, vegetables and nuts to be grown in the province. Aubergines and garlic appeared at every meal, alongside the mounds of fresh coriander, parsley and dill that are used to create fragrant bases for stews and emerald-green kuku (a type of frittata).

Eating habits and culinary preparations in this area have several distinct characteristics. In this rice-producing region, the consumption of rice is much higher than elsewhere in Iran which is prepared in this region in a kateh cooking style. Although the diet of the region is primarily vegetarian, animal products also play a significant part in their food. The people eat great quantities of poultry and eggs and wildfowl.

Seafood is also a particularly strong component of Gilani cuisine. Sturgeon, often smoked or served as kebab. Other types of fish such as mahi sefid, kuli, kulmeh, Caspian salmon, mahi kapur and many others are consumed. Fish roe or ashpal, is widely used in Gileki cuisine.

The production and consumption of dairy products on the plain, where only cattle are raised, is limited. the only products derived from cow and buffalo milk are yogurt and, butter and buttermilk.



Mirza Qasemi, Torshi Tareh, Baqali Qatoq Fesenjan ,Anarbij, Seer Qalieh, and Kalkabab ,Zeitoun Parvardeh and Morgh-e Torsh are some of local dishes.



ECONOMY

The existence of a free trade zone, customs, anzali port and fishery (shilat) make this zone as one of the most important economic centers in Iran.

BANDAR ANZALI PORT



Bandar Anzali is the largest port in northern Iran and is one of the most active ports of the Caspian Sea. It is the third largest seaport in Iran. 7/3 percent of the transit to Iran and more than 50 percent of Gilan goods are transported through this border.

Annually from this maritime boundary more than 4 million tons of goods are imported and more than 288 thousand tons of fuel and 55 thousand tons of non-oil goods are transported to or outside the country.

The main import goods of this customs are ironware, wood and board, machinery and some other industrial items, as well as major export goods including minerals, agricultural products, food products, handicrafts, industrial goods, construction materials, chemical materials.

ANZALI FREE ZONE



Anzali Free Trade-Industrial Zone is a wide area of the port city of Bandar Anzali about 3200 hectares and about 8 kilometers of sea border and up to 2 kilometers into the sea, which included industrial, trade and commercial, tourism and services sections.

The most important feature of Anzali Free Zone is the presence of shopping malls and stores filled with Chinese goods and Indigenous people who work in this area have become as mediators of Chinese products. The goal of a free trade zone is to enhance the global market presence of the Country or location by attracting new business and foreign investments. By contrast, it has created a good field for developing Chinese products.

According to the report, the number of domestic and foreign tourists visiting the coastal region rose to nearly 5 million in 2016 Which is 75% higher than the previous years.

SHILAT



The Iranian Fisheries Organization (Shilat) is the main agency responsible for fisheries and aquaculture management. Shilat is in charge of resource protection and rehabilitation of existing stocks, improvement of habitats and stocking of Iranian marine and inland waters, as well as the development of fish farming and fish production through research, training and promoting technical services.

AGRICULTURE

Agriculture in this district encompasses a wide range of different activities due to its particular geography, climate, geology and human factors.

Historically agriculture and forestry, logging and fishing are the bases of Gilan's economy.

The warm and humid weather has allowed this region to grow crops that require very large amounts of moisture. Some major agricultural products include rice, tea, silk, citrus, beans, sugarcane, vegetables, beef, poultry, fish and timber.

This district was a major producer of silk beginning in the 15th century CE. As a result, it was one of the wealthiest provinces in Iran. As early as the 16th century and until the mid 19th century, Gilan was the major exporter of silk in Asia.

In the mid-19th century, a fatal epidemic among the silkworms paralyzed Gilan's economy, causing widespread economic distress. After that Gilan's agriculture and industry reorientated from silk to production of rice and tea.

Today's rice cultivation is the main agricultural products and nearly 70% of this area is under cultivation of rice, while tea plantation is going to disappear in this area.



WEEKLY BAZAARS



These bazaars are held on certain days of the week, and more so in the smaller cities and large villages. Most sellers in these markets are farmers and gardeners. Formerly in these bazaars were sold only local food and Agricultural products, handicrafts, poultry, meat and other commodities but today products from other cities or other countries like China, Russia are sold.

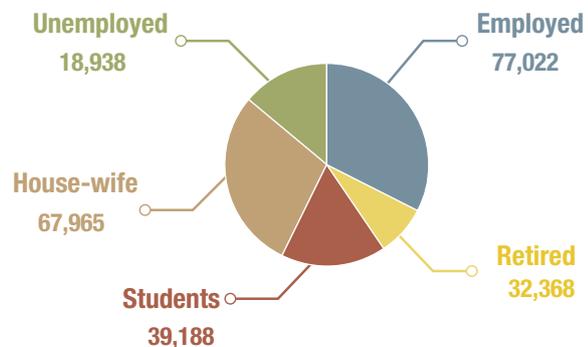
FISH BAZAAR



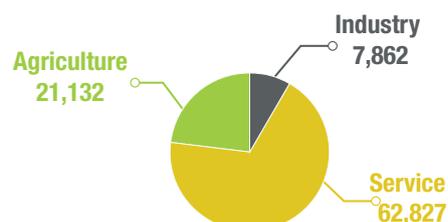
Fishing is the primary source of livelihood for the inhabitants of Anzali. The fish bazaar is one of the most spectacular and vibrant places in this area. Many fisher folks sell fresh fish by spreading it on the ground, under the old city bridge in the traditional market of Anzali. Caspian white, Trout, Mullet, Zander, Smoked fish, Salted fish, Roe are the main type of fish that are sold in this area.

OCCUPATION

Although the region is economically one of the important poles of the country, but the people of this region are not economically well-positioned. The unemployment rate in this region indicates that 22% of people are unemployed.



As can be seen in the chart below, the Majority of people work in the services sector, and only 20% of them are in the agriculture sector. Considering that this region is one of the fertile regions of the country. By investing in this field, the economy of this region can be improved.



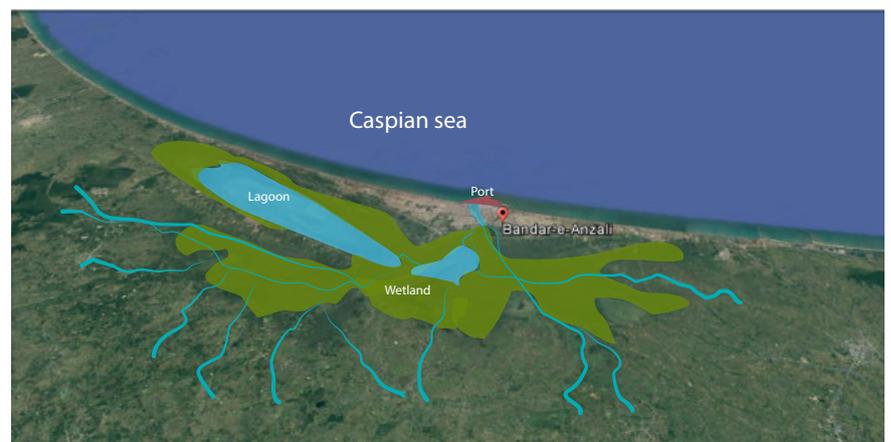
ANZALI WETLAND



Anzali Wetland Complex is located near the port city of Bandar Anzali on the southern coast of the Caspian Sea. This sweet water lagoon spans an area of 193 km² in the spring and winter and an area of 80 square kilometers in the fall and summer.

It is composed of the diverse ecosystem including freshwater lagoons, extensive reed-beds, shallow impoundments and seasonally flooded meadows. Ecological components of the wetland interact in a complex manner, which provides important habitats for many fishes and wintering waterfowl.

This permanent wetland fed by 11 main rivers also it is surrounded by seasonally flooded marshes, farmlands (mainly paddy field) and fish ponds and 30 tributaries empty into the lagoon after watering rice paddies and farmlands along their course.



The wetland was registered as a Ramsar site in June 1975 in accordance with the Convention on Wetlands of International Importance, especially as Waterfowl Habitat.

FLORA

Plants have important roles in the wetland ecosystem. They are the producer of the ecosystem and support the lives of other organisms. They also provide habitats such as spawning and nursery grounds for fish and nests for birds. The dominant vegetation throughout much of the Anzali Wetland consists of vast Reedbed (*Phragmites australis*). About two-thirds of the whole Anzali Wetland including almost the entire eastern and central portion of the main wetland is covered by Reeds. Anzali is also home to lotus flowers which are considered sacred in many Asian cultures. Water lilies are another fabulous beauty of Anzali lagoon. Pink water lilies with their green heart-shaped leaves cover the lake and make a magnificent view.



SPECIES COMPOSITION

Plant species in the Anzali Wetland can be broadly classified into three groups: emergent plants, submerged plants and floating plants.

EMERGENT PLANT

Emergent plants live near the water's edge. These plants often have deep and dense roots that stabilize shallow soils at the water's edge. They also provide important habitat for birds, insects and other animals living near water.

They are largely distributed in the shallow area of the eastern wetland, and covers about a quarter of the wetlands excluding the lagoon.

Common reed, *Typha australis*, *Sparganium neglectum*, *Solanum persicum*, *Iris pseudacorus*, *Calystegia sepium*, *Sagittaria trifolia*, *Alisma plantago-aquatica*, *Carex divulsa*, *Scirpus lacustris*, *Cyperus longus*.



SUBMERGED PLANT

Submersed are rooted to the bottom but their leaves grow entirely underwater. Due to this, they may grow to greater depths than emergent and floating plants. they create valuable habitat for fish and small invertebrates and food for ducks and aquatic mammals.

The submerged plant's community covers almost the entire area of the lagoon.



Potamogeton crispus, sago pondweed, Potamogeton natans, Coontail, Myriophyllum demersum, Hydrilla verticillata, Vallisneria spiralis, Najas marina, Chara.

FLOATING PLANT

These plants float freely on the water surface. They cover about a quarter of the Anzali Wetland except for the lagoon.



Indian Lotus ,Lemna minor, L.trisulcata, Spirodela polyrrhiza, Wolffia arrhiza, Hydrocharis morsus-ranae, Hydrocotyle Ranunculoides, Trapa natans, Salvinia natans, Nymphoides indica, Nymphaea alba.

FAUNA

AVIFAUNA

The Anzali wetland is important for a wide variety of breeding, passage and wintering waterfowl. The wetlands support a large breeding colony of *Chlidonias hybrida*, small colonies of six species of Ardeidae, and a large resident population of *Porphyrio porphyrio*. The wetlands also support wintering concentrations of ducks, geese, swans and coots. The Anzali wetland is the most important wintering area in Iran for Pygmy cormorant, regularly holding more than 500 in mid-winter. Great white pelican, *Pelecanus crispus* , Eurasian bittern and Lesser white-fronted goose are occasional winter visitors in small numbers, while White-headed duck, Caspian plover, Sociable lapwing and *Gallinago media* have been recorded on passage. *Beccaccia eurasiatica* is a common winter visitor to the surrounding damp woodlands and scrub, while Moustached warbler and *Acrocephalus arundinaceus* are common breeding birds in the reed-beds.



MAMMALS

31 species of mammals in 14 families inhabit the Anzali watershed. There is a population of *Lutra lutra* (Eurasian Otter) in the wetland that is listed as “Vulnerable¹²” in the IUCN Red List.



The Golden Jackal (*Canis aureus*), Common Otter (*Lutra lutra*), Jungle Cat (*Felis chaus*), Common Badger (*Meles meles*), Eurasian otter, porcupine, weasel, Caspian seal and jackal are the prominent mammal species in Anzali.

REPTILES AND AMPHIBIANS

Four species of snakes (*Natrix natrix*, *Oligodon taeniolatus*, *Coluber juglaris* and *C. najadum*), as well as five species of lizard, occur in the Anzali Wetland .

Frogs from four families represented by 13 species are distributed around the wetland, of which two species (*Batrachuperus persicus*, *Rana macrocnemis* or *Rana pseudodalmatina*) are protected.



ICHTHYOFAUNA

There are 49 fish species in the Anzali Wetland, of which 8 species are non-native and 39 are native species.

Non-native species consist of *Carassius gibelio*, grass carp, sharpbelly, Silver carp, *Pseudorasbora parva*, *Anguilla europea*, Bighead carp and *Gambusia holbrooki*.

Among the 39 species of native fishes, 30 are found in the south district of the Caspian Sea, and the other 9 species are also found in other fresh waters of Iran. Among the 30 native species at Anzali, there are 8 species *Alosa caspia*, Caspian barbel, *Leucaspis delineatus caucasicus*, *Perca fluviatilis*, Rudd, Angora loach, *Proterorhinus marmoratus* and *Pelecus culteratus*, which are only found in Anzali Wetland and not in any other part of the southern Caspian Sea area, thus these species are of biodiversity importance.



PROTECTED AREA AND WILDLIFE REFUGE



In the Anzali wetland three reserves such as Siakeshim, Selke and Sorkhankol have been established.

SORKHANKAL

Sorkhankal wildlife refuge is located at the center of Anzali Lagoon, this 477-hectare refuge is home to migrant birds in the winter and also the habitat of indigenous and migrant fish species. This area is also important as the spawning ground for some threatened fish such as *Abramis brama* and *Rutilus frisii*, and feeding area of *Lutra lutra*.

SELKE AB-BANDAN

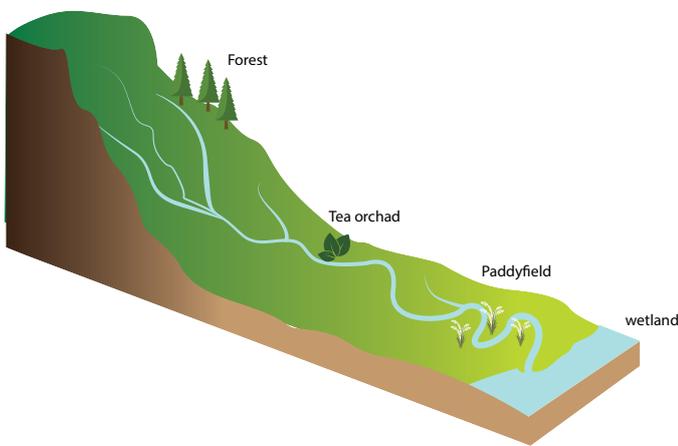
It is situated on the southern edge of the main wetland and comprises 360 ha of shallow freshwater marsh and flood meadows with tall reed beds to the north and arable land to the south. It is extremely important for a wide variety of breeding, passage and wintering waterfowl and many of the threatened species that inhabit in this area.

SIAKESHIM

Siakeshim is a protected area. It provides spawning grounds for fish and nesting areas for bird species. This area is very important because *Haliaeetus albicilla* inhabits the area, and some fish move to the river through Siakeshim for spawning.

THE ANZALI WETLAND WATERSHED

The Anzali Wetland watershed is geomorphologically divided into 2 types of landforms, a lower plain flat land in the north and a mountainous area in the south. The plain, generally below 100 m, consists mainly of the Anzali Wetland and wide paddy area. The natural gradient is less than 1 % in the plain inclined toward the Anzali Wetland, and the gradient of the mountainous area increases to more than 25 % from the limit of the plain up to 3,000 m. The relation between the topography and land uses in the Anzali Wetland watershed is shown below.



THREATS

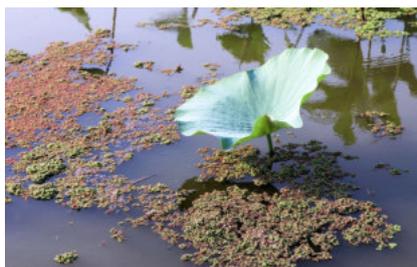
The anzali lagoon was registered as a Ramsar site in June 1975. However, due to the range of interference caused by human activity, the Wetland has been degraded, and the area was listed in the Montreux Record as a priority site for conservation measures in 1993. Environmental conditions in the Anzali Wetland have been degraded due to the inflow of sewerage, wastewater and solid waste, and soil from upstream areas.

Major activities that need to be managed in a sustainable manner for the conservation of the Wetland are summarized as follows:

! INTRODUCTION OF EXOTIC SPECIES

The main exotic plants in anzali lagoon are azolla and Water hyacinth that by spreading over the lake they reduced sunlight penetration to water. Alien invasive species have had severe impacts on local aquatic flora and fauna.

AZOLA



It is a floating aquatic fern, with very fast growth, capable of spreading over lake surfaces to give complete coverage of the water in only a few months. It was brought in 1981 from the Philippines for studies on its nitrogen fixation capacity and then distributed in paddy fields to strengthen rice fields. At present almost all sheltered open-water areas in the southern and eastern basins are covered by a dense mat of this fern which also penetrated deeply into the Phragmites stands.

WATER HYACINTH



Water hyacinth is a free-floating aquatic plant native to tropical and sub-tropical South America. It is one of the fastest growing plants known. It is not exactly known how water hyacinth found its way to Iran, some experts speculate that the plant was imported as an ornamental plant in 2011.

! UNSUSTAINABLE AGRICULTURAL ACTIVITIES



The wetland is surrounded by seasonal farmlands (mainly paddy field) and fish ponds . 30 tributaries empty into the lagoon after watering rice paddies and farmlands along their course. Drainage and run off from fertilized crops and pesticides used in agriculture introduce nitrogen and phosphorous nutrients and other toxins like mercury to water sources. These chemicals can affect the health and reproduction of species posing serious threats to biological diversity.

! SEWAGE AND LANFILL

The inflow of polluted wastewater and solid waste from domestic, industrial is another main cause of water pollution. The amount of the solid waste dumped into the rivers is roughly estimated to be 66 tons/day¹⁴. Such garbage may contain hazardous chemicals and is also detrimental to the landscape of the Anzali Wetland. The toxic substances contained in the waste can directly cause negative impacts on the flora and fauna of the Wetland.



! BOATING

Chemicals used to clean, protect, and run boats often leach into the water, severely impacting the environment and weakening or killing the wildlife. Aquatic plants and animals have specific requirements for light, temperature, pH level, and more, and toxins from detergents, paints, petroleum products, batteries, and metals have disastrous effects on wildlife's ability to survive and thrive.



! POACHING

Apart from licensed fishermen, there is also an unknown number of poachers. There are no permanent fish landing sites on the lagoon and there is no control over the fish catch. Uncontrolled hunting can lead to the decline or even the extinction of some species.



! BUILDING CONSTRUCTION ON THE MARGINS

Roads and bridges are frequently constructed across wetlands. Road and bridge construction activities can increase sediment loading to wetlands. Roads can also disrupt habitat continuity, driving out more sensitive, interior species, and providing habitat for hardier opportunistic edge and non-native species. Roads can impede movement of certain species or result in increased mortality for animals crossing them. Borrow pits (used to provide fill for road construction) that are adjacent to wetlands can degrade water quality through sedimentation and increase turbidity in the wetland.



! RIVER SEDIMENTS

The total annual load of nutrients for the eleven streams entering the Lagoon is 4.898 ton of nitrogen and 378 t of phosphorus. Much of this is transported directly to the sea through the Lagoon's outlets, while about 38% remains in the Lagoon.





THE RAMSAR CONVENTION

The Ramsar Convention is an intergovernmental environmental treaty established in 1971 by UNESCO. It provides for national action and international cooperation regarding the conservation of wetlands, and wise sustainable use of their resources.

The Convention was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975. Since then, almost 90% of UN member states, from all the world's geographic regions, have acceded to become "Contracting Parties".

Under the 3 pillars of the Convention, the Parties have committed themselves to:

1) Wise use of wetlands

Through national land-use planning, appropriate policies and legislation, management actions, and public education;

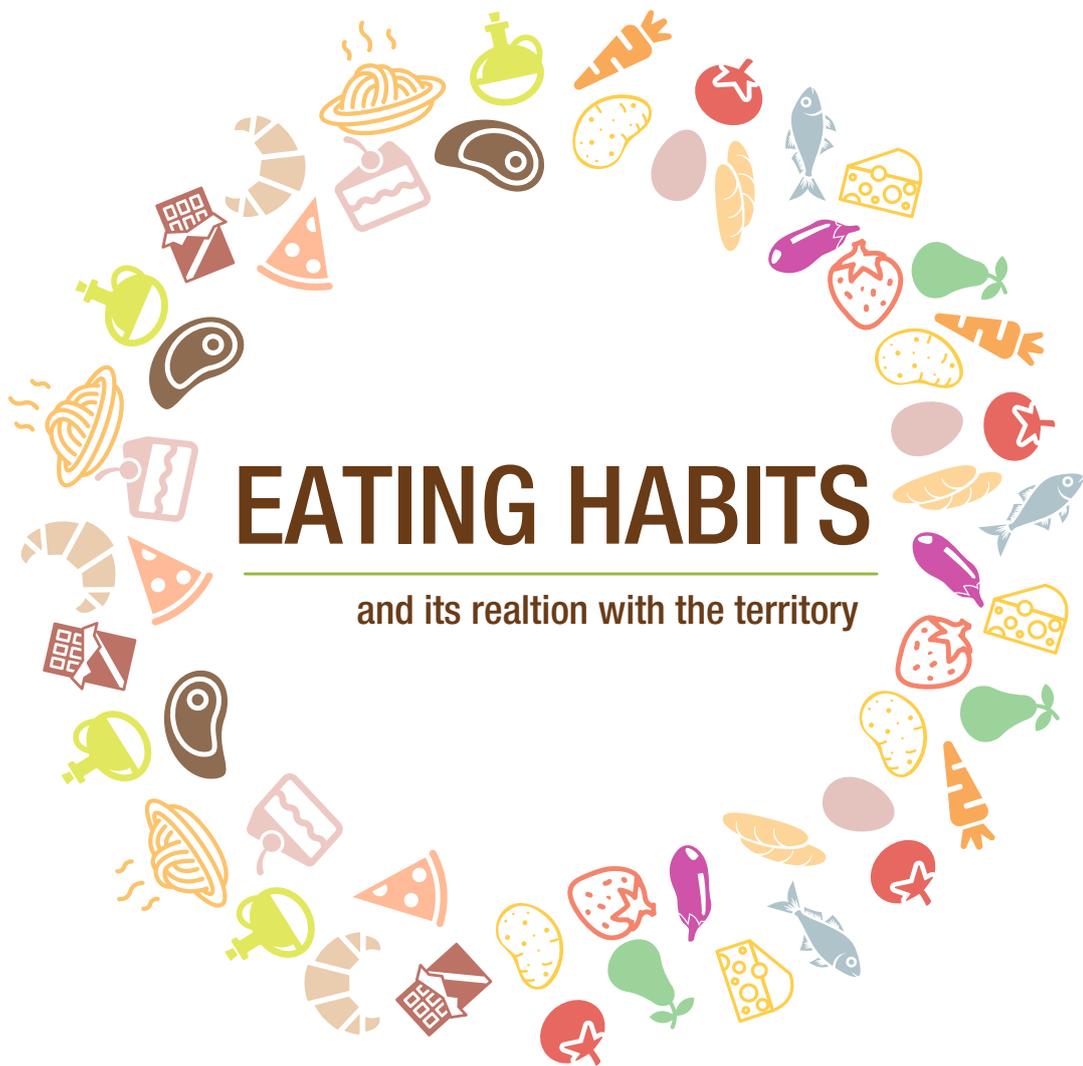
2) The List of Wetlands of International Importance

Designate suitable wetlands for the list of Wetlands of International Importance and ensure their effective management;

3) International cooperation

Contracting parties agree to consult with other Contracting Parties about implementation of the Convention, especially in regard to trans boundary wetlands, shared water systems and shared species.





EATING HABITS

and its reallion with the territory

Food that was available 50 years ago was very different from what is available today . Only certain fruits and vegetables were available at any given time . it depended on what was in season which meant that fruits and veggies weren't chemically preserved or sprayed. Many families had access to farm raised veggies and also fresh meat . Food came right out of the garden and into the kitchen and was eaten fresh it was not processed or muddled around with. The soil was rich so the food grow was more nutritious.

TRADITIONAL EATING HABITS OF GILAN



In general, Rice is the staple food of the populations of Gilan. Until the last decades, it was still common to have rice with all three daily meals. People would eat about 900 grams of rice a day, which represented between 40 to 65 percent of his daily diet.

Here is a daily diet of A Gilak In the 1950s :

BREAKFAST

Traditionally, kate (steamed rice) was the main food for breakfast. It could be eaten cold (usually leftovers from the day before), accompanied by cheese, preserved garlic, onion, fish roe, uncooked broad beans soaked in water, nuts, and olives, or eaten hot, with sweetened milk, mixed with syrup or jams. In the past thirty years, bread has gradually replaced rice, and a common breakfast consists of tea, cheese, butter and jam.

MID-MORNING

The usual mid-morning collation (qalye nahar) included boiled vegetables (beans, beets), possibly seasoned with lime juice and a dash of olive oil.

LUNCH

The ever-present kate (rice) was served with stews, browned or salted fish, yogurt, onion, and raw herbs (in the spring and summer).

THE MID-AFTERNOON SNACK (ASRANEH)

Similar to the mid-morning collation or simply a soup with sour flavors.

DINNER

A vegetable cake (kuku), a soup, stewed leftovers, or fried eggs were served with the kate, which now competes with bread. In the last decades eating bread has become popular.

CURRENT EATING HABITS

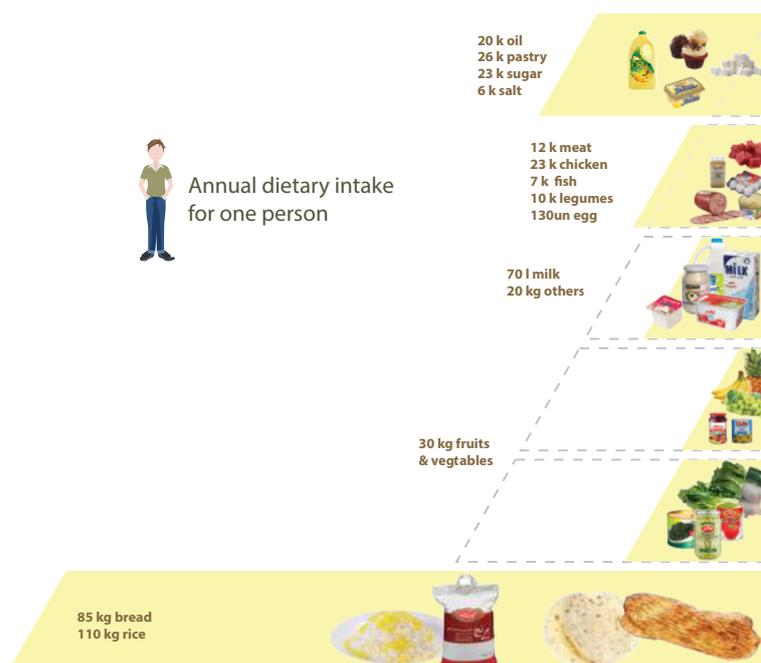
Although many eating habits have changed from the past, rice-based diet is still used by all people in Iran. The food consumption pattern of people in Iran shows that Iranian consume an average of 100 g of rice per day, that is four times more than the global average. In fact, they dedicate a big proportion of their meal to carbohydrate and small parts of their food belong to others. It also illustrates that they dedicate only a small proportion of their diet to vegetables and fruits.

Similarly, the consumption of meat and dairy in Iranian diet declined dramatically, consumption of fish, milk, red meat, eggs and poultry reduced by 42%, 39%, 37 %, 2%and 1% respectively during the last decades. According to statistics, out of every 100 Iranians, only four have a satisfactory intake of dairy products. Every Iranian drink less than 70 liters of milk per year, while the global per capita rate stands around 300 liters. Even though the consumption of main food has decreased but the rate of carbonated drinks consumption among Iranians exceeds four times the global average. While per-capita consumption of soft drinks in the world is 10 liters per person, Iranians consume an annual average of 42 liters including cokes, tonics, seltzers, minerals, and sparkling water.

Between 2006 and 2015, food consumption of Iranians declined by 28%, according to a report by the Central Bank of Iran.

In addition to the amount of consumption, some habits have also changed; Today people prefer more processed foods. Canned, frozen, packaged food have been substituted with fresh and seasonally products.

CURRENT FOOD PYRAMID

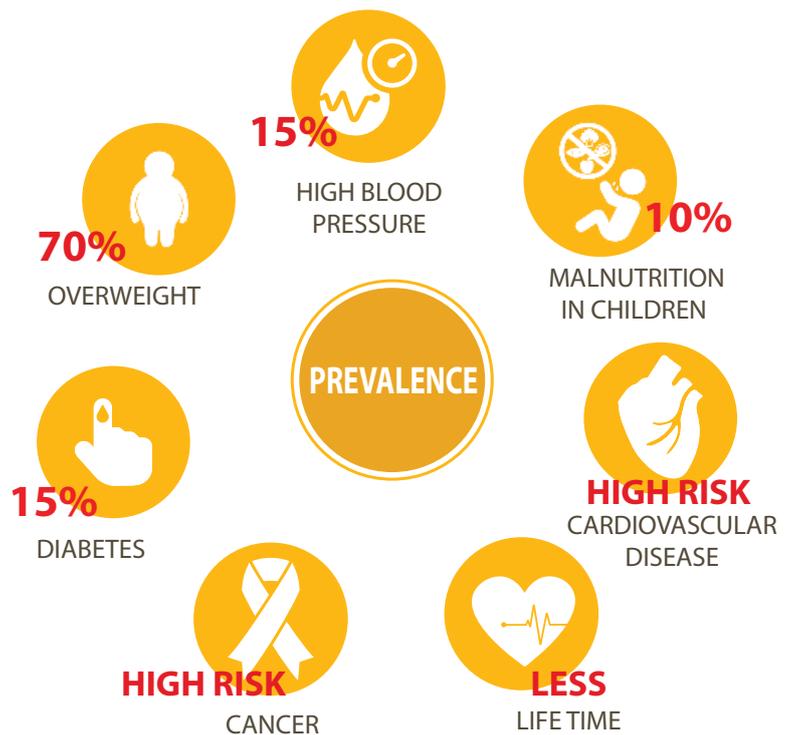


HEALTH SITUATION

Eating unhealthy and unbalanced diet can lead to many negative effects on the overall health. An unhealthy diet is one of the major risk factors for a range of chronic diseases, including cardiovascular diseases, cancer, diabetes and other conditions linked to obesity.

Diets high in saturated fat and calories and low in nutrients can contribute to illness and obesity. According to the world health organization, Iran is among the first seven countries in the world with regard to the high prevalence of obesity in adolescents; Nearly 31% of youths ages 6-19 and 70% of adults are overweighted. High cholesterol, diabetes, and high blood pressure are some of the health problems associated with obesity. Also, diet is thought to be partly responsible for about 30% to 40% of all cancers. According to statistics 13% of deaths registered in 2015 in Iran were associated with overweight and obesity.

The chart below illustrates the main health problem in this region:



As can be seen, people live in an inappropriate situation of food in this region. To overcome this crisis, we should first understand how people provide their food because eating fresh and healthy food has a significant effect on human health. Next part is research to understand that the territory how much food can provide for people and how it can fulfill the need of food for people.

UTILIZED AGRICULTURAL SURFACE

In this territory, the utilized agricultural surface is 47,000 ha, considering the total area is 90,000 ha, Nearly 52% of the land surface is being used for agriculture.

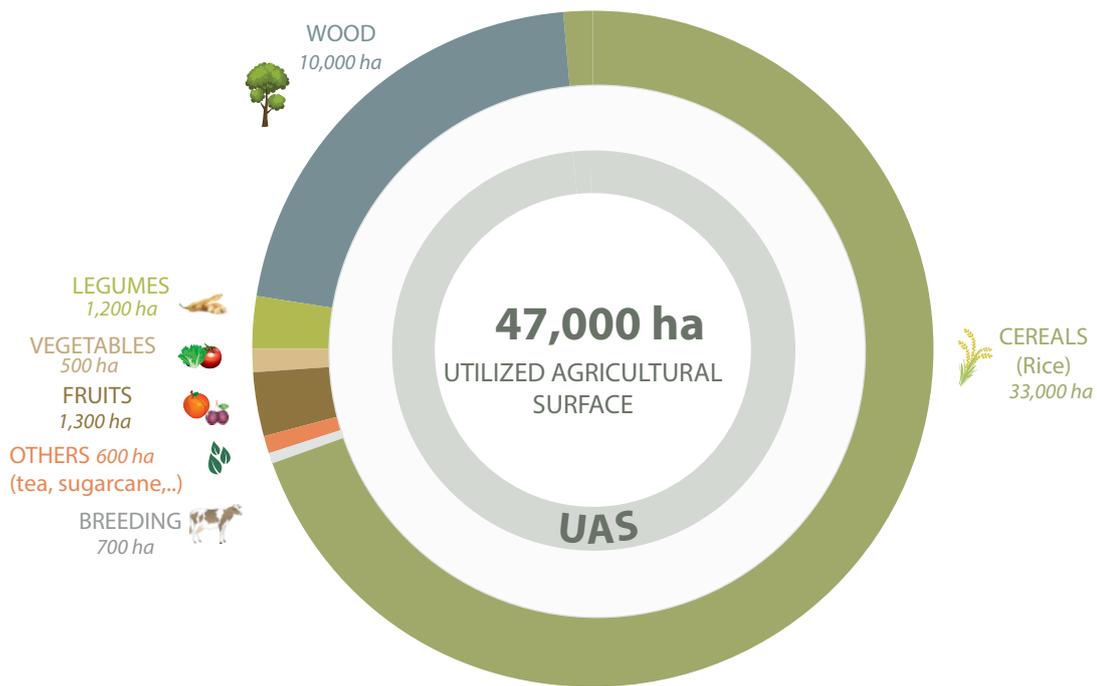


Because of the abundant amount of rain and fertile land, the largest part of the agricultural surface is dedicated to the cultivation of rice. After rice, near 10,500 hectares of the cultivated soil belongs to tree farming in which the main part belongs to the cultivation of Populus trees for wood making and mulberry trees for sericulture.

Cultivation of fruits, legumes, and vegetables are also allocated nearly 6.5% of total agriculture surface.



In this territory there isn't enough forage and pasture to feed the livestock living there; And because of some privacy, there isn't enough information about the amount of these activities.



AGRICULTURAL PRODUCTION

In this section, to evaluate the coverage of demand by this territory, the comparison between the amount of supply and demand are discussed.

As mentioned before cereal cultivation in this region is limited to only rice cultivation and only an insignificant amount of land is dedicated to wheat and barley. Annually, nearly 110,000-ton rice are cultivated in this region, that is far more than people need. So in addition to supplying the need of the population living on the territory, it provides a good proportion of rice on the national level.

	supply / ton	demands / ton
	110,000 ton	15,000 ton
	0 ton	15,000 ton

The amount of fruit produced in this territory is not sufficient enough to fulfill the need of people. Nevertheless, a big part of the fruit is exported to other territories and a bigger amount is imported to meet the fruit need inside the territory.

	28,000 ton	30,000 ton
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Given that just over 1% of the agricultural land to vegetable cultivation, it provides only a small proportion of need of people in this region and annually a big proportion of vegetables are imported from other cities.



Legume is another main agricultural crop in this region because they are used in much traditional food, but the amount of production is insufficient and doesn't meet the need of people, Nevertheless, a large proportion of rashti beans that are cultivated only in this region is exported to other cities.



Due to the presence of rivers, wetland, and Caspian sea, fish production is one of the most important productions in this region and annually approximately 8,000 ton is produced that is substantially more than their needs.



Chicken is another main ingredient of traditional food of people, and annually a significant amount of chicken is produced and exported to Northern cities of Iran.



In the same way to chicken production, the egg is another product that is produced more than people's needs.



Cattle breeding in this area is not well-suited; lack of forage and insufficient pasture for livestock grazing are two main reasons that breeding activities can't provide adequate meat for people and only a small fraction of total need is produced in the territory.

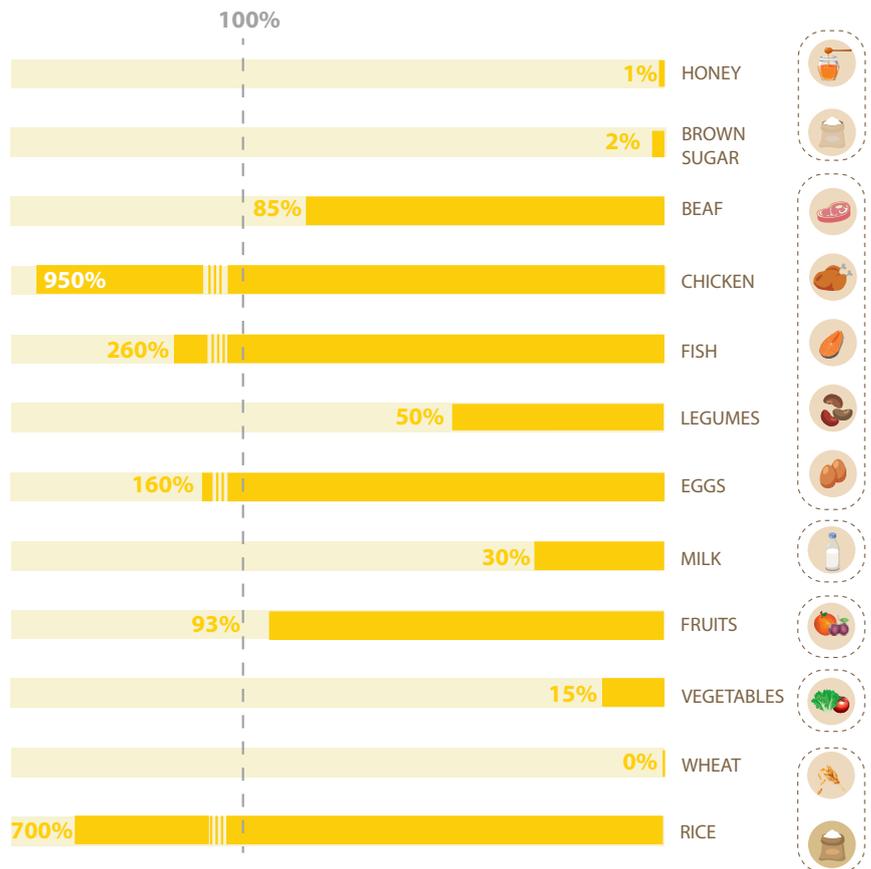


Similar to meat also milk production is insufficient to fulfill the need of the inhabitants of the territory.



According to the amount of production and also considering the population of the region, it is illustrated that the amount of production doesn't meet the need of people.

The chart below illustrates the percentage of production of each product according to the needs of the people of the region.



As can be seen, the production of some products such as rice, chicken, and fish are more than needs and the majority of these products are exported to other cities. However for some other crops and products, even though there is the possibility of production, unfortunately, they are still imported.

So, although this region has one of the most fertile lands in Iran but for fulfilling the need of its inhabitant, it depends on the other cities.

The agricultural surface in this region isn't divided in a good way so in the first step it should be redesigned in a way that a sufficient amount of each product is produced in the territory. For achieving this goal, we need some information about the proper amount of each ingredient that everybody needs, consumption pattern plays a very important role in the food system.

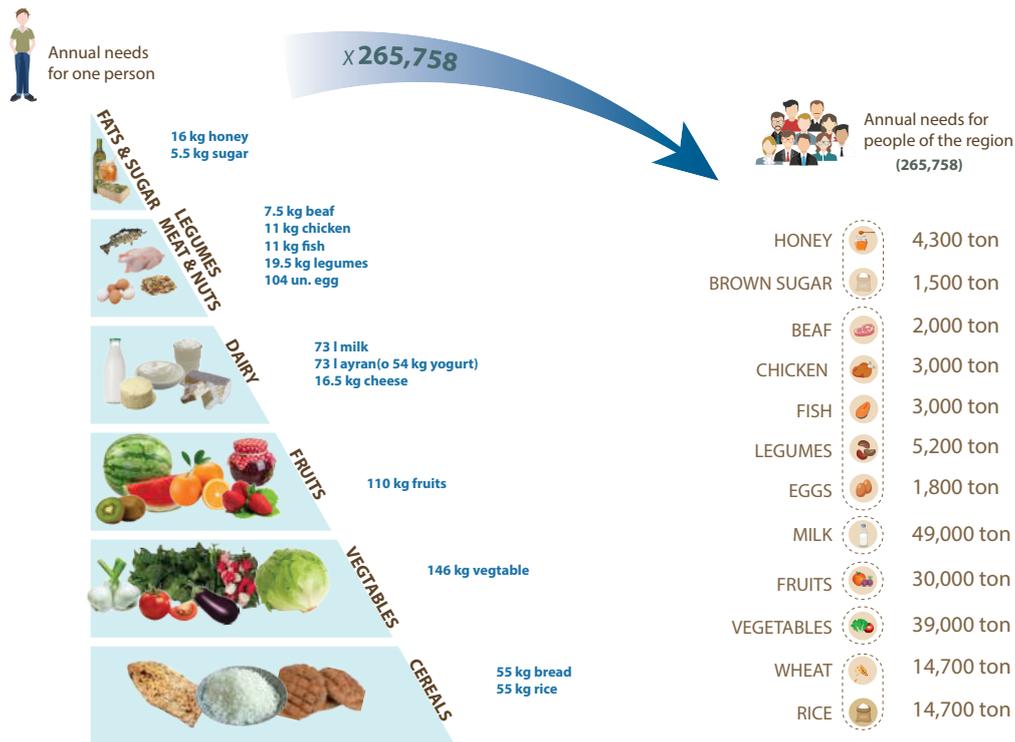
FOOD PYRAMID

Food Pyramid is a visual tool that is used as a guide in designing a healthy diet. It represents the optimal number of servings to be eaten each day from each of the basic food groups. Foods that contain the same type of nutrients are grouped together on each of the shelves of the Food Pyramid.

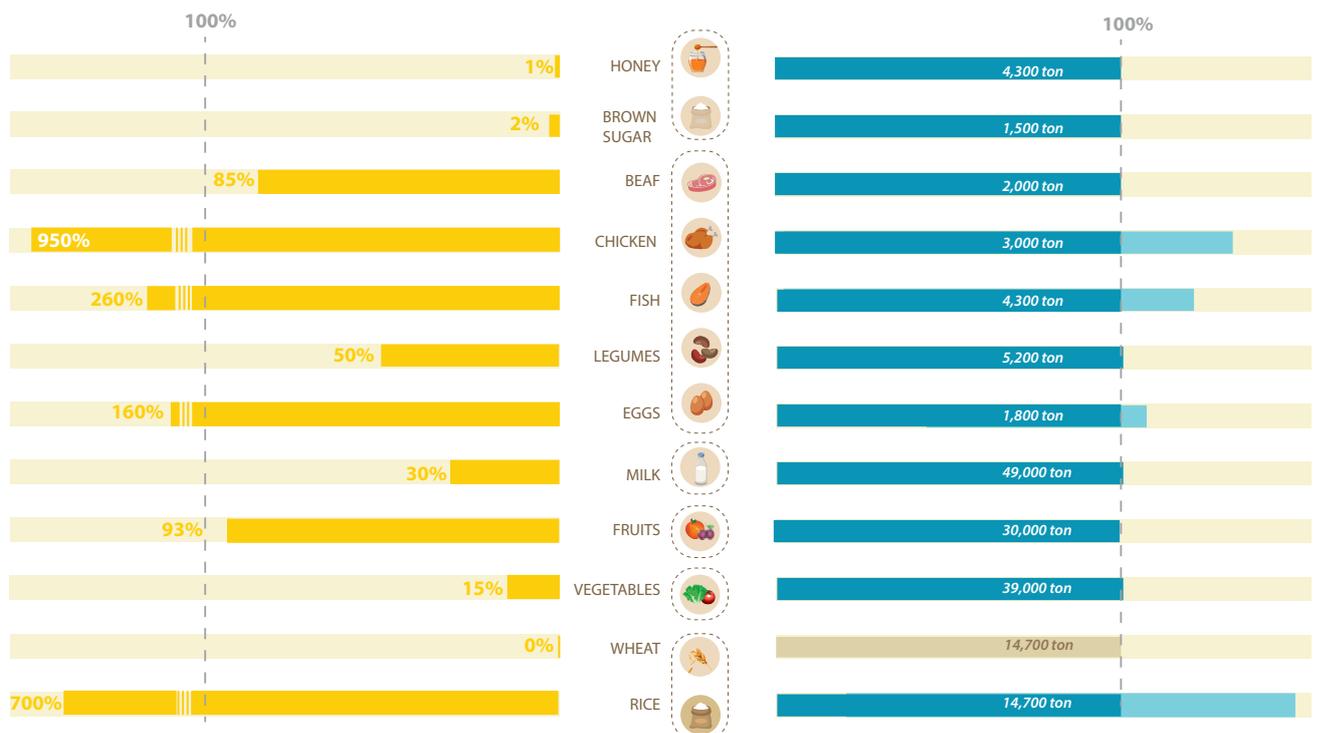
The 2015 version of the Iranian dietary guidelines were prepared by the Department of Community Nutrition in the Ministry of Health and Medical Education; with the involvement of the School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences; Iranian Nutrition Society; and the National Nutrition and Food Technology Research Institute, Tehran.



Current eating patterns can be moved toward healthier eating patterns by making shifts in food choices over time. Making these shifts can help support a healthy body weight, meet nutrient needs, and lessen the risk for chronic disease.

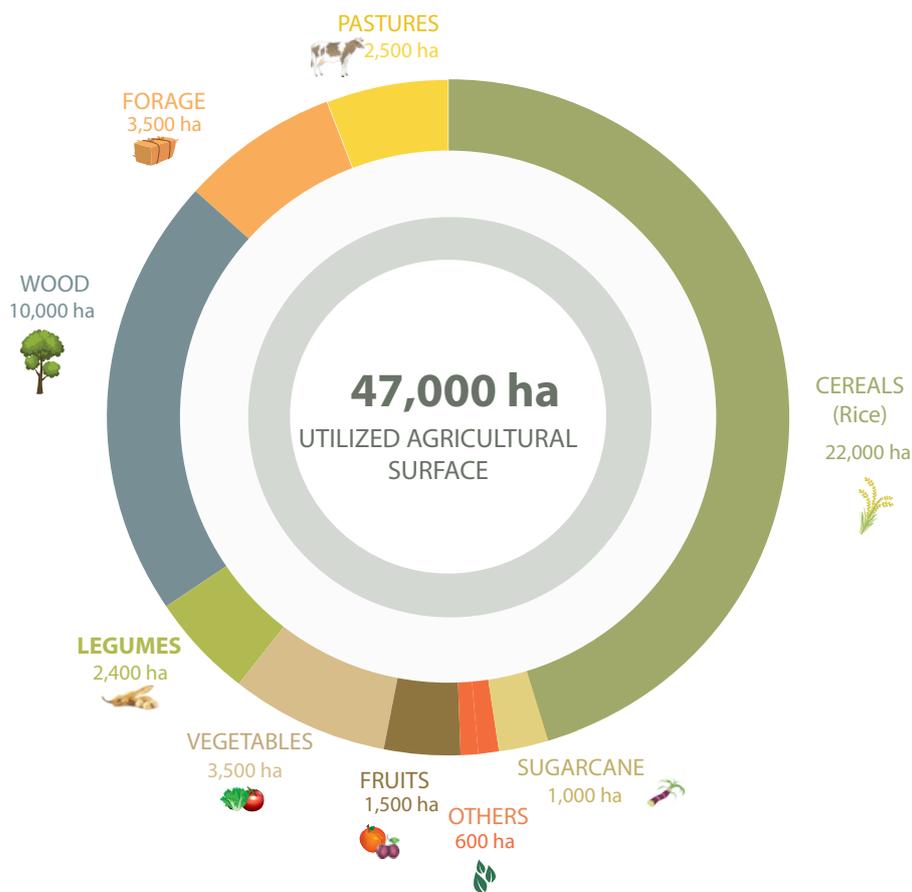


Having the optimal number of servings to be eaten each day from each of the basic food groups for each person, we will be able to determine how much food the territory need for fulfilling all inhabitation.

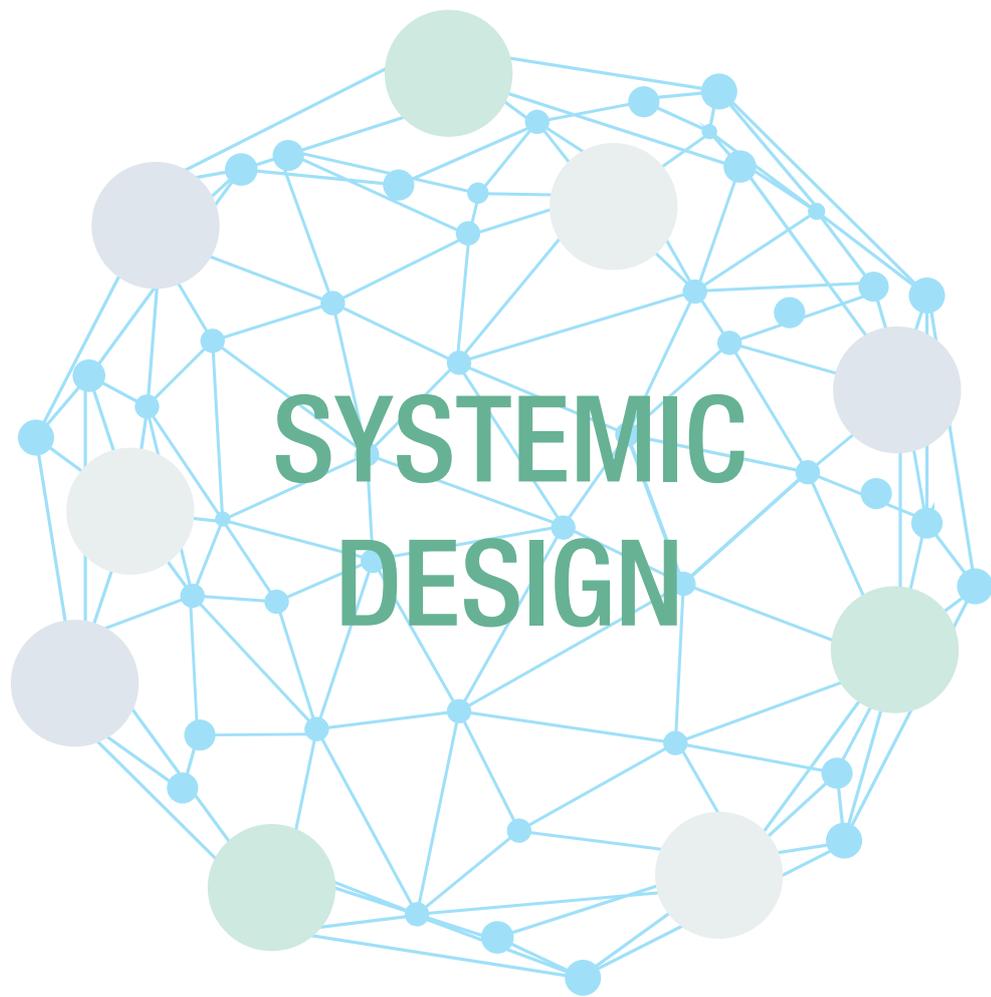


As mentioned before in the actual system, the Agricultural land has been distributed very unevenly and it couldn't fulfill the real need of people in the territory. By having enough information about the need of the people living in the territory, we will be able to reprogram the Utilized Agricultural Surface. Dedicating the proper amount of land to each production activities, the territory generates the proper amount of food for fulfilling the people.

NEW UTILIZED AGRICULTURAL SURFACE



By comparison news agriculture surface with previous one, it is clearly seen that in the new one, more land is dedicated to fruit and vegetables that have a significant role in the human health, furthermore some land has been devoted to providing feed for animal, it is very essential because as mentioned before lack of feed for livestock is the main reasons that breeding activities can't provide adequate Production activities such as sugarcane cultivation in this region are going to be disappeared, while they have good potential for providing people's need, so they should be improved.



**SYSTEMIC
DESIGN**

SYSTEMIC APPROACH

A Systemic Approach is required to create a net of relationships in which a system output becomes the input for another one. The creation of a relationship network is then promoted, producing a general wellness improvement in people, activating cash flow between the various system actors, and improving production processes through continuous transformation of matter. The cultural and value systems is so spontaneously redefined, with direct environmental benefits. (Bistagnino, 2011)

Systemic design recognizes the value of nature, that in different territories, provides different useful resources for our survival, but also our well-being. Ecosystems are able to live in symbiosis, in a network of relationships in which everyone plays a fundamental role.

The systemic design incorporates the concepts of the Blue Economy of Gunter Pauli, who sees the earth as an ecosystem where we have to learn to live in symbiosis with other species. Blue Economy is based on the theory of the ZERI that aims to give rise to productive activities without generating any type of waste. In fact, in nature there is no waste, everything comes back into circulation, everything is transformed to be able to use it through the collaboration of the different five natural kingdoms: 1) bacteria; 2) algae; 3) mushrooms; 4) plants; 5) animal.

The new systemic economic and productive model is based on five principles:

- The OUTPUT (waste) of a production system become INPUT (resources) for another, trying to limit waste that can be helpful to create new activities or improvement of existing ones. This reserve benefits by increasing economic flows and creating new job opportunities;
- RELATIONSHIPS that are generated between the actors involved, no one should prevaricate on others, because the whole system would be affected. All things are considered as strategic elements and the relationships can be both internal and external;
- SELF PRODUCING the system is autopoietic, It supports and reproduces itself by defining its own field of action and coevolving jointly with other existing systems.
- ACT LOCALLY in the territory means stimulate socialization and get stronger human relations and values its human local resources, culture and material and solves problems by creating new opportunities, It is clear the reduction of

the costs of logistics and its relative emissions of harmful substances in the environment.

- MAN AT THE CENTER OF THE PROJECT which has direct relations with its environmental, social, cultural and ethical context. Through the systemic design, human being takes back the right position at the center of this scenario troubled by goods and individuals who seem to be homologated with the same needs and interests.



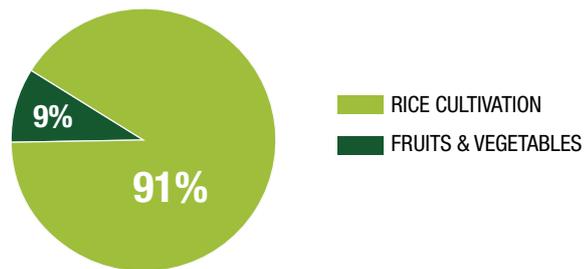
AGRICULTURE

Fruits & Vegetables

CURRENT AGRICULTURE



The fertile land in this region ensures that a wide variety of crops are able to grow and thrive. However, as mentioned before the main agricultural land is belonged to rice cultivation and only 9% of the land is devoted to other crops.



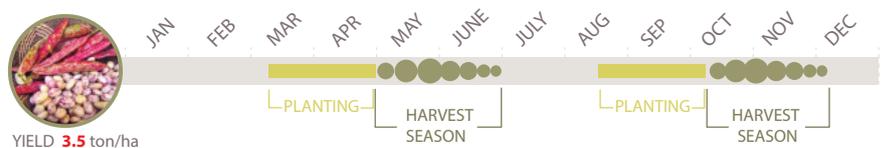
This section focuses more on the fruits and vegetables that are cultivated in this region and rice cultivation is discussed in the next section.

The crops listed below are the most commonly cultivated crops in this region :

MAIN CROPS

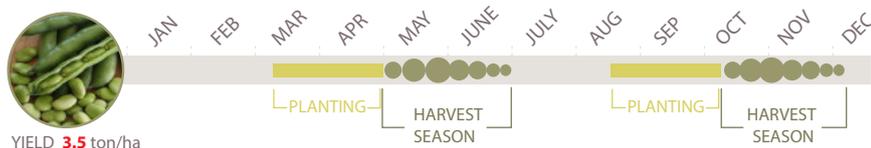
PERSIAN FAVA BEAN (PACHE BAGHALI)

Pache baghali is one of the most popular legumes that is cultivated in this area. It is an annual plant which is grown for its edible dry seeds or unripe fruit. Pache baghali is one of the raw material that is used in much traditional foods in this region.



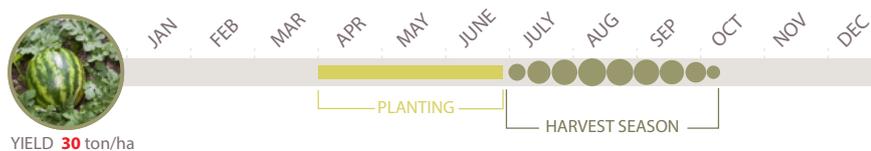
FAVA BEAN

Fava bean is another main legum, while in many countries it is primarily cultivated as a seed crop, livestock, cover crop and so on, But in Iran, fava bean planting is done to provide food. In fact like Pache baghali, fava is one of the main ingredients in traditional gilak food.



MELON

Cultivation of watermelon is one of the activities in the small villages on the shore of wetlands. It is an annual plant that for growing, requires lots of space, sun, water, and nutrients. During the last decades, water shortage is one of the main problems that farmers are faced with for cultivation of watermelons.



CUCURBITA

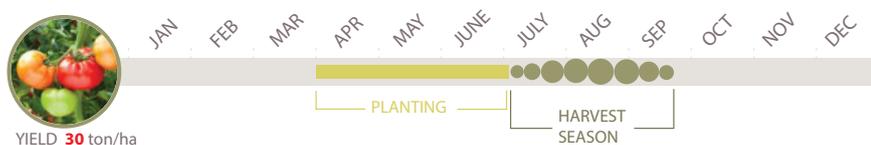
Different type of Cucurbita is cultivated in this district. Traditionally it was the raw material of many food and desserts in winter.

A type of Cucurbita that is called Calabash is also cultivated that is used for some type of the handicrafts in this region.



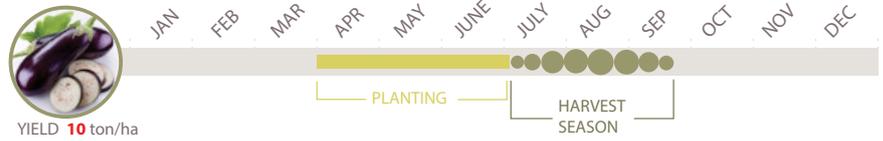
TOMATO

Tomato is another crop that is cultivated in this zone. It is consumed in diverse ways.



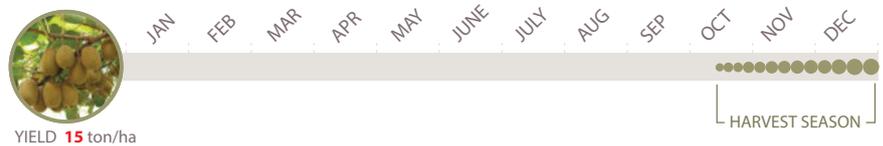
EGGPLANT

The eggplant is a delicate, tropical perennial . Grilled Eggplant is used in many traditional foods.



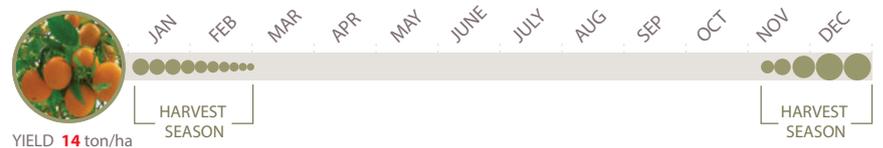
KIWI

Kiwi is a winter fruit. It was first brought to Iran in 1968. Early production, abundant products, reasonable price have caused farmers to grow and produce this fruit in this region during the last 30 years.



CITRUS

The seaside lands of the Caspian Sea provide the finest conditions for the production of various types of citrus, particularly orange, bitter orange. Bitter orange blossom jam is one of the souvenirs of this region in spring.



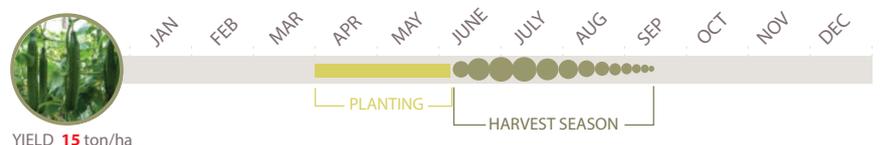
CHERRY PLUM

It is a species of plum, that is usually processed for making jam, paste, torshi (pickled vegetables)and traditional ice pop.



CUCUMBER

cucumber is also cultivated in 150 ha in this district.



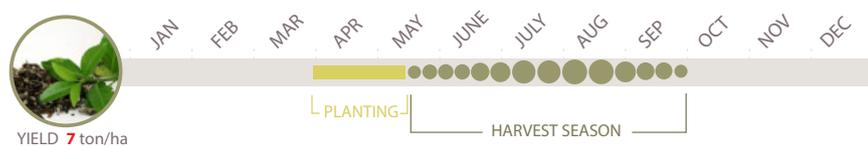
Apart from above, there are some other important crops that in previous they were planted and harvested in this area, however, today's farmers are reluctant to produce these products because they prefer farming products with more yield and demand.

TEA

Tea is the most common drink in Iran and tea plantation has been practiced for a long time along the shores of the Caspian Sea .

The history of tea culture in Iran started at the end of the 15th century. Before that coffee was the main beverage in Iran. Because most of the coffee producing countries were located far from Iran and shipping was very difficult, they tried to import tea from India and soon it became the national drink.

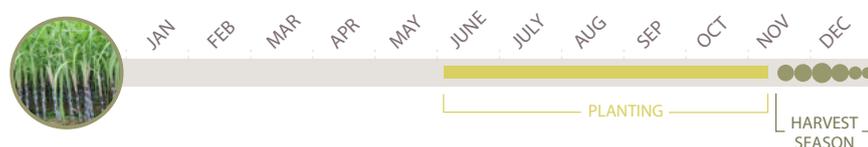
Before plenty of cultivated land was dedicated to tea cultivation, however, today the country's tea industry is deep in trouble, and tea cultivation has decreased significantly during last decades.



SUGARCANE

Another product in this area is sugarcane, which is called “sugar pipe in Gilaki. Up to half a century ago, it was considered to be a major crop in these areas, and its cultivation was very common among farmers, but in recent years it has been rarely cultivated and is gradually extinct.

Sugarcane is a tropical, perennial grass. It is sensitive to the climate, soil type, irrigation, fertilizers, insects, disease control, varieties, and the harvest period. Sugarcane is used to produce sugar.



Bagasse, molasses, and filtercake are the main by-products resulting from refining sugarcane into sugar. They are very useful and can be used as a biofuel, animal feed or fertilizer.

INTENSIVE AGRICULTURE

Farmers in this region pursue intensive agriculture methods nowadays.

Intensive farming or intensive agriculture is a kind of agriculture that aims to maximize yields from available land through various means such as heavy use of chemical fertilizers, insecticides, fungicides, and herbicides. It is associated with the increasing use of agricultural mechanization, which has enabled an increase in production. While it is true that the production increase with this farming model nevertheless it doesn't support the quality of final products.

In the following the main practices during cultivation are discussed :

INPUTS

SEED PREPARATION



The main goal of farmers is to increase yields effectively, during the last decades with the advent of genetically modified seeds and abundant advertising many farmers are encouraged to use GMOs seeds. In fact in GMOs seeds, by manipulating their genes they will be able to have new characteristics, like insect resistance, larger yields, and faster-growing traits. The technique used in this type of crop ensure farmers that are able to improve crop in a more efficient way. But unfortunately, GM seeds have many negative effects. Most of the concern surrounding GMO's relates to their potential for negative effects on the environment and human health.

CHEMICAL PESTICIDES



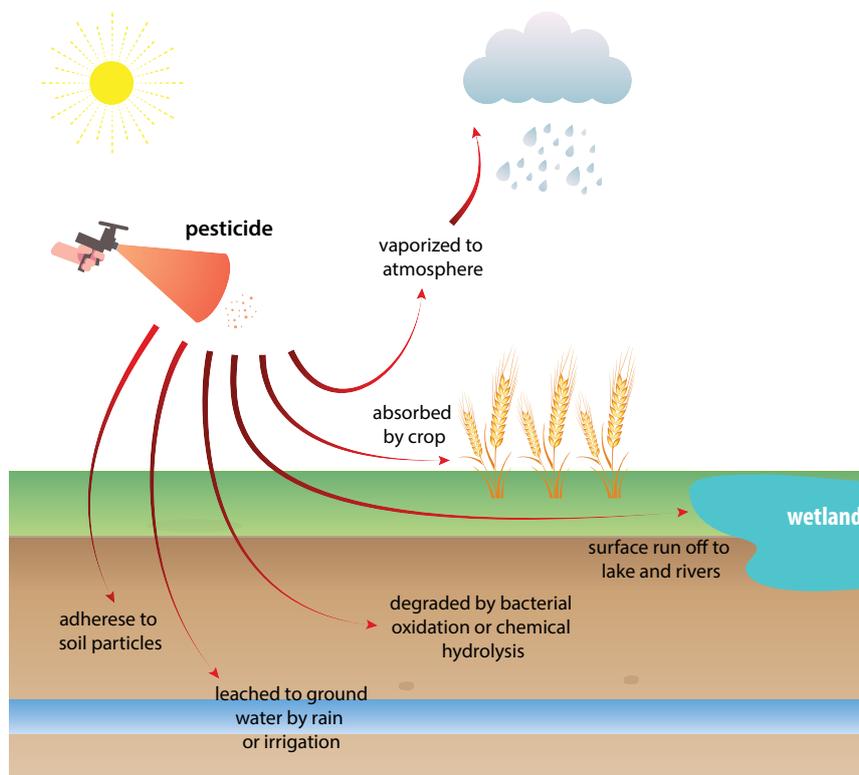
The second harmful practice is the use of chemical pesticides, herbicides, fungicides. The usage of them allows farmers to control weed species, harmful insects, unwanted plants and plant diseases that can afflict crops. Due to their prevalence, these compounds can potentially pollute all tissues of life on earth and can drastically alter the natural balance of the ecosystem.

Pesticides kill not only the pests but also the natural enemies of these pests, a problem known as 'resurgence'. Resurgence means that natural control of pests is disrupted severely and crops suffer as a result. Resurgence can also create new problems, minor pests that are usually kept at low numbers will multiply quickly in the absence of their enemies.

Another important effect is that pests can and do eventually become resistant to the chemicals. When sprayed with chemicals, most pests will be entirely susceptible. However, not all pests are killed, some with a slight variation in their genetic make-up are resistant and therefore survive. Every succeeding generation of the surviving pests will have the same pesticide-resistant

genetics and eventually, the pests will become entirely resistant to the pesticide. Unaware of how to deal with this problem, farmers often increase their use of pesticides, causing further problems.

Moreover, even though pesticides are sprayed on land, many times, they can make their way into a water source. When pesticides are flushed away into water bodies, they alter the state of them by changing to their physical, chemical or biological conditions, thereby making them toxic, contaminated and unsuitable for use. So it can throw the whole ecosystem off balance and can have deleterious effects on human health, such as for elicit immune suppression, hormone disruption, diminished intelligence, cancer and so on.



CHEMICAL FERTILIZER

Chemical fertilizers are another chemical compound that are used by farmers to promote soil fertility and increase plant growth.

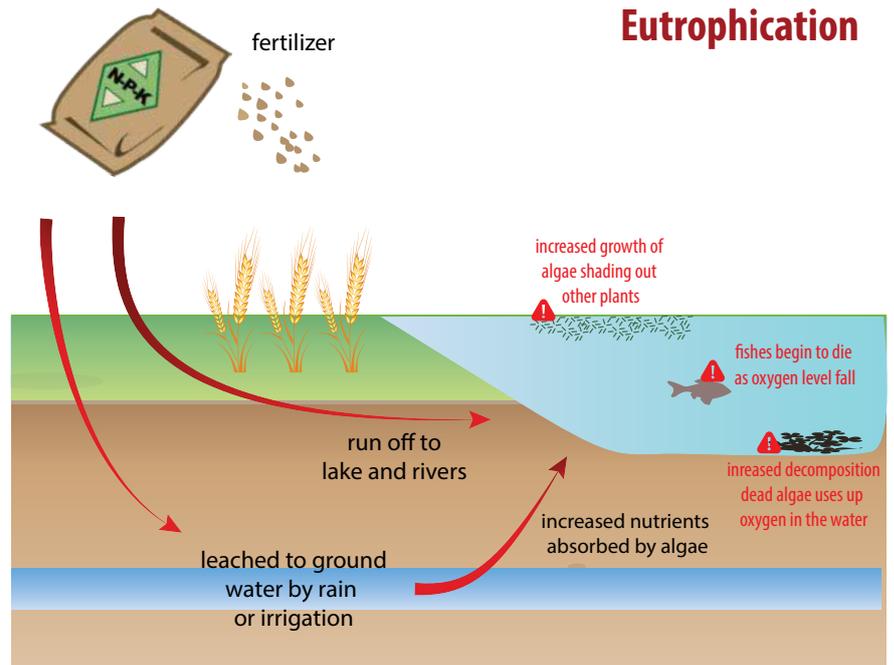
They are designed to give all the nutrients-Nitrogen, Phosphorous and Potassium that plants need in appropriate proportions. Inorganic fertilizers do not need a certain time to be broken down or decomposed and can be readily absorbed by plants, so many farmers tend to use them more.

Similar to chemical pesticides, chemical fertilizers can also disrupt ecosystem and endanger natural resources.

One of the greatest effects of fertilizer use is eutrophication. It occurs when



fertilizers washed off the land by rainwater into rivers and lakes. The fertilizers quickly travel down small streams and rivers to reach large bodies of water and deluge them with an excess of nutrients. The resulting increase of nitrate or phosphate in the water encourages algae growth, which forms a bloom over the water surface. This prevents sunlight from reaching other water plants, which then die. Bacteria break down the dead plants and use up the oxygen in the water so the lake may be left completely lifeless.



Eutrophication

WATER



In Gilan despite the heaviest rainfall, due to unequal rainfall distribution and the lack of ability to store surface water, the province is faced with a shortage of water, so the use of groundwater resources is increasing significantly in recent years.

Intensive use of groundwater for irrigation leads to the lowering of water tables and reducing its potential for future use. It also generates multiple negative externalities, including salinity, stream depletion, or land subsidence that directly affect agricultural productivity and the environment.

Another factor to consider is that current agricultural practices are typically inefficient in water use. Problems such as growing high water demand crops, leaky and inefficient irrigation infrastructure, the unsustainable draining of aquifers to produce crops are the main problems.

CULTIVATION TECHNIQUES

MONOCULTURE

Mono-cropping or monoculture refers to the planting of a single crop throughout a field or growing area.

The two most significant reasons for why monoculture has been the most prevalent practice around the world are reduced labor or effort and maximum output or produce.

Although this method is very popular among farmers, but it has many negative impacts. Monoculture increase susceptibility of disease, pest infestation, drought, and nutrient depletion. When a single type of crop is cultivated in large numbers and with plants in close proximity to each other, the likelihood for insect or disease infestation rises. The lack of diversity found in monoculture production enables invasive pests and diseases to quickly proliferate and devour an entire field of precious crop. With the increased prevalence of insect and disease infestation, farmers turn to the usage of pesticides, fungicides, and herbicides in an attempt to sterilize fields. Even without an infestation, a tilled and nutrient depleted monoculture will still require an excessive amount of external inputs, like chemical fertilizers, to feed the soil.

The lack of diversity in a monoculture system eliminates all the functions that nature provides to plants and the soil. It means that there are no varieties of plant that naturally provide nutrients to the soil, such as nitrogen-fixing legumes, or ground cover crops that can be slashed and left to improve the nutrient content of the topsoil. It means that there are fewer species of microorganism and bacteria on the soil as there are fewer nutrients available for them to survive on, and it undermines the integrity of the soil by not having a variety of plants with different root depths.



OUTPUTS

FRUIT AND VEGETABLES

Fruits and vegetables that produced in this ways are contaminated by the chemicals applied during cultivation. Chemical residues generally remain in crops or their produces for a period of time. Food containing pesticide residues have deleterious effects on human health.

ORGANIC WASTE

Many organic waste such as branches, buds produced during different steps of cultivation are discarded without considering that they can be used to synthesize new products.

INORGANIC WASTE

Also many inorganic waste from packaging or other process throw out that generate growing adverse effects on the environment of the agro-ecosystem.

INCOME

It can often prove to be difficult to understand just how much local farmers can earn from working their land. As a general rule, however, the average local farmer in Gilan does not earn a large income from the crops that he will sell. Like all farmers around the world, Gilak farmers can expect to only reap back a small percentage of the value of the crop that they are selling.

In recent years the government took steps to cut back on agricultural taxes in an effort to encourage farmers to continue working their land, but these efforts are not truly sufficient to help the majority of hard working farmers dig their way out of poverty.

The increasing difficulty of a Gilak farmer to earn a decent living and work his way out of a poverty situation has often resulted in several younger generations moving out of the family farming business and going to work in one of the many other industries that have started to thrive in Gilan.

With a lack of young freshmen to work on the farms, it can be difficult for farmers to keep up with all of the work that their farms require on a daily basis.

CURRENT



Resource

	Energy from net	Non renewable energy
	Drinking water	Water depletion
	Petrol	Non renewable energy

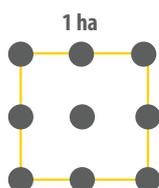
Inputs

	GM seeds	Loss biodiversity Threaten human health Increase herbicide
	Chemical fertilizer	Soil contamination water contamination Eutrophication
	Chemical pesticides	Loss biodiversity Threaten human health Soil contamination Water contamination Air Pollution
	Contaminated manure	Soil contamination Threaten human health

Outputs

	Fruits & Vegetables	Contaminated with chemical residue threaten human health
	Branches	Not valued
	Packaging materials	Non recyclable Environmental pollution
	Spoiled fruits	Not valued Soil contamination

Agriculture methods



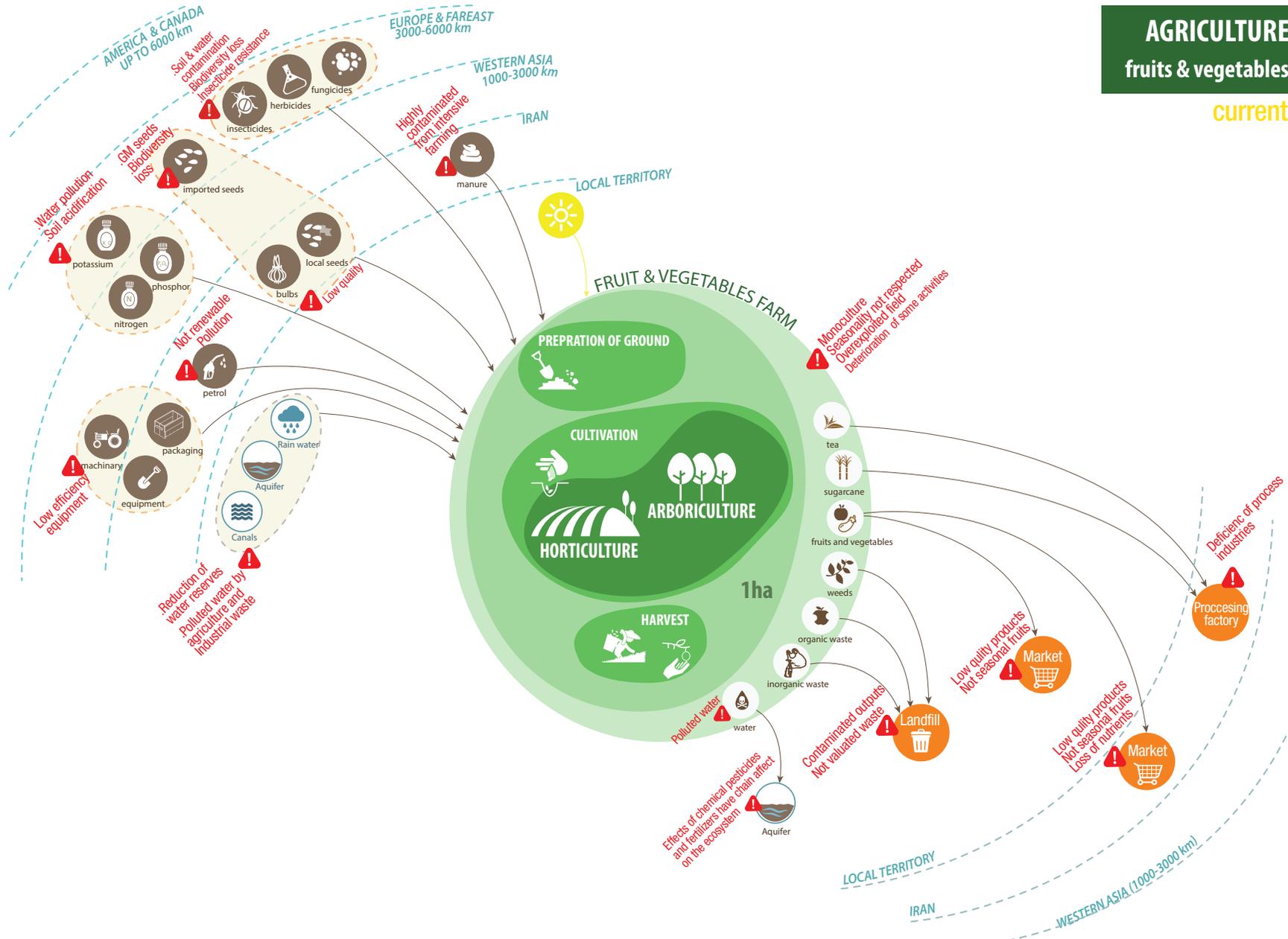
Monoculture

Soil Degradation
Changing Organism Resistance
High use of fertilisers
High use of pesticides
Loss of biodiversity

AGRICULTURE

fruits & vegetables

current



SYSTEMIC AGRICULTURE

Once examined all the fluxes and analysis the current situation and identified the problems, the next step is to find a sustainable solution for each problem.

Sustainable agriculture seeks to use nature as the model for designing agriculture systems. There are no waste products in nature. Outputs from one organism become inputs for another. The death of one organism becomes food for other organisms. So by finding nature functions and utilizing them, we can sustain our land resource base, while at the same time reduce costs and increase profitability.

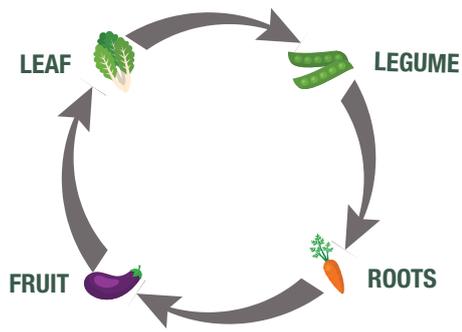
CROP ROTATION

One of the most important practices in sustainable agriculture is crop rotation. It involves growing different types of crops in the same area at different times of the year or in different years. It helps in reducing soil erosion and increases soil fertility and crop yield.

With rotation, a crop that leaches the soil of one kind of nutrient is followed during the next growing season by a dissimilar crop that returns that nutrient to the soil or draws a different ratio of nutrients. In addition, crop rotation mitigates the buildup of pathogens and pests that often occurs when one species is continuously cropped, and can also improve soil structure and fertility by increasing biomass from varied root structures.

Another benefit of crop rotation is that it produces different types of products which means a more varied diet and more types of products are produced.

The image on the next page indicates which crops are in the groups that suffer from the same pest and disease problems and which should therefore not be planted in rotation.



LEAF : Broccoli ,Cabbage ,Cauliflower ,Lettuce ,Spinach

LEGUME :Pea , Beans,Broad bean, Fava

ROOTS : Carrot,Turniips, Onion, Potato,Beetroot

FRUIT : Eggplant, Potato, Tomato,Cucumber,Squash,Melon

INTERCROPPING



Another useful agriculture practice is intercropping. It is the cultivation of two or more crops simultaneously on the same field. Intercropping adds diversity to the cropping system and diversity tends to lead to stability.

Intercropping reduces the insect pest populations because of the diversity of the crops grown. Moreover, it attracts more beneficial insects, especially when flowering crops are included in the cropping system.

Apart from that, it minimizes labor cost on the control of weeds. A mixture of various crops gives often a better coverage of the soil leaving less space for the development of weeds.

Finally intercropping improves soil fertility through biological nitrogen fixation with the use of legumes, increases soil conservation through greater ground cover than sole cropping, and provides better lodging resistance for crops susceptible to lodging than when grown in monoculture.

	Pea	Carrot	Broccoli	Cucumber	Onion	Spinach	Watermelon	Bean	Chili	Tomato	Apple
Pea		✓	✓	✓	✗			✓	✗	✓	✓
Carrot	✓		✓			✓		✓	✓		
Broccoli	✓			✓	✓	✓			✗	✗	✗
Cucumber	✓		✓					✓	✓		✓
Onion	✗		✓			✓		✗		✓	✓
Spinach	✗	✓	✓	✓	✓			✗		✓	✓
Watermelon											
Bean		✓		✓	✗	✗			✓	✓	
Chili	✗	✓	✗	✓				✓			✓
Tomato			✗		✓	✓		✓			
Apple	✓		✗	✓	✓	✓			✓		

DRIP IRRIGATION

A very efficient and exacting method of irrigation is drip irrigation. It is a controlled irrigation in which precise amounts of water is slowly delivered to the root system of multiple plants. Drip irrigation is delivered to plant roots through a series of pipes, tubes, and valves. These parts allow water to be focused in a particular area.

Drip irrigation has many benefits it delivers water directly to the crop's roots, meaning less water is wasted and more money saved.

Additionally, because water is being delivered directly to the plant, drip irrigation cuts down on weeds, other pests, and disease.

Finally, it has Environmental benefits Because there is less chance of erosion, with very little runoff ending up in area streams and rivers.



BEE KEEPING

Most of the vegetables are pollinated by honeybees. Even plants that are capable of self-pollination tend to produce in greater quantities when pollinated by the honeybee. Of course, there are other pollinators such as the carpenter bees and other insects, but they aren't always as efficient as honeybees and they can often become more of a nuisance than a help.

So putting and managing them in the right way can help farmers and growers improve yields, crop quality and consistency.

Apart from that, it could be as a new source of income for farmers.



BIOLOGICAL PEST CONTROL

Biological pest control is a method of suppressing or controlling the population of undesirable insects, mites, weeds and plant diseases by their natural enemies.

There are three basic types of biological pest control strategies: importation, in which a natural enemy of a pest is introduced in the hope of achieving control; augmentation, in which locally-occurring natural enemies are bred and released to improve control; and conservation, in which measures are taken to increase natural enemies, such as by planting nectar-producing crop plants in the borders of rice fields.

On the next page, some of the beneficial insects that could help eliminate and control pests are shown.





ladybird



lacewings



Hoverfly



Mantis



Aphidoletes
aphidimyza

To attracting these beneficial insects to the farm, some beneficial plants are cultivated around the farm.



Coriander



Garlic



Mint



Chives



Basil



Lavender



Nasturtium



Marigold



allium



Rosemary

ORGANIC FERTILIZER



Organic fertilizers are carbon-based compounds that increase the productivity and growth quality of plants. They have various benefits over chemical fertilizers. Use of these organic fertilizers ensures that the fruit and vegetables are free of harmful chemicals. As a result, the end consumers who eat these organic products are less prone to diseases. Also, The majority of organic fertilizers can be prepared locally or on the farm itself.

In addition to the on-farm production possibilities of organic fertilizers, organic fertilizers help in maintaining the soil structure and increasing its nutrient-holding capacity. Therefore, a farmer who has practiced organic farming for many years will require far less fertilizer, because his soil is already rich in essential nutrients.

MANURE

Manure is known as a “complete” fertilizer; it has a lot of organic matter. manure generated by the sustainable breeding are of an enriched quality, as a result, soils are nourished in an accurate mode because it is not polluted and provides a high quality of nutrients.

OUTPUT MANAGEMENT

As mentioned before in the systemic approach there is no waste, in fact, the waste is valued and are used. The recycling and utilization of agricultural wastes are considered to be the important step in environmental protection, energy structure, and agricultural development.

Agricultural waste such as leaves, weed are considered to be potential resources for making organic fertilizer.

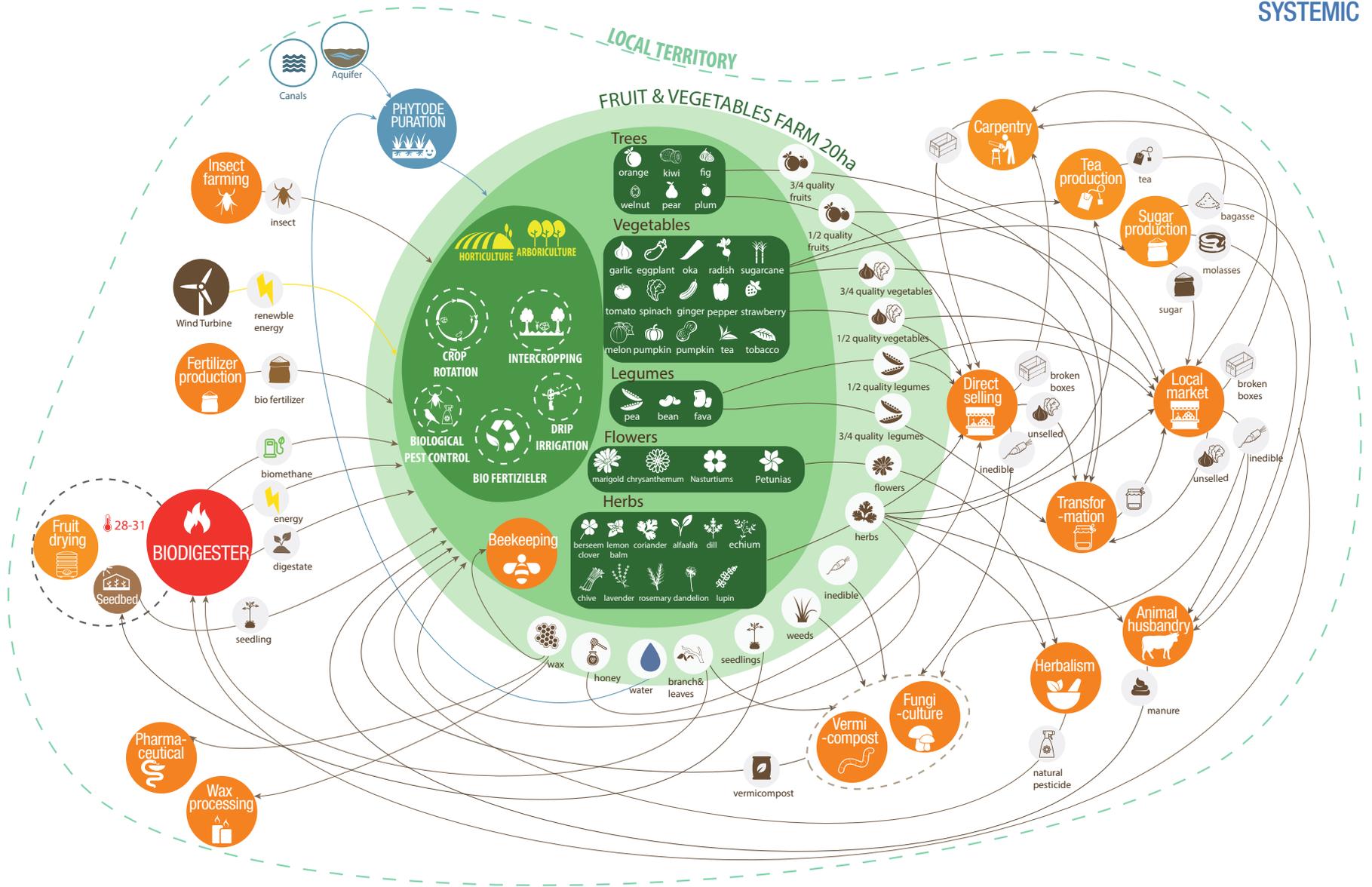
One of the methods of fertilizer production is vermiculture that is production of organic fertilizer from earthworms by using organic waste as raw materials. The final product that is called vermicompost, contains a lot of macro and micro nutrients, such as nitrogen, potassium, phosphorus, calcium and magnesium.

Organic waste found on farms can be also utilized as an input for biodigester. Anaerobic digestion is a series of biological processes in which microorganisms break down biodegradable material in the absence of oxygen. One of the end products is biogas, which is combusted to generate electricity and heat, or can be processed into renewable natural gas and transportation fuels. Another product is digested which is a nutrient-rich substance that can be used as a fertilizer.

The water waste issue can be solved by phytodepuration. Phytodepuration is a purification technique that uses plants to filtrate the contaminated water. Plants have an elevated capacity to absorb and use certain elements, thus preventing the contamination of surface or subterranean water bodies; they also promote microorganisms in the soil that attack and destroy a good portion of organic pollutants.



AGRICULTURE
fruits & vegetables
SYSTEMIC



CURRENT

SYSTEMIC

Resource



Energy from net

Renewable energy from biodigester or wind turbine



Drinking water

Water from phytodepuration



Petrol

Biomethane from biodigester



Inputs



Imported seeds

Self-production of seedlings



Chemical fertilizer

Digestate from biodigester
Vermicompost
Green manure



Chemical pesticides

Biological pest control
Biopesticides
Physical Pest Control



Contaminated manure

Manure from local farms



Outputs



Spoiled fruits



Spoiled fruits



Branches



Branches



Packaging
Non recyclable



Packaging
recyclable



Fruits &
Vegetables



1/2 quality
fruits and
vegetables



3/4 quality
fruits and
vegetables



Herbs &
flowers

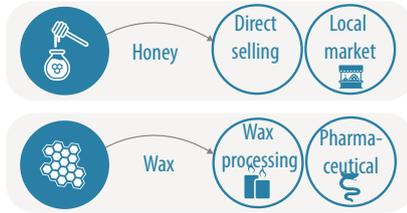


NEW OUTPUTS

CURRENT

SYSTEMIC

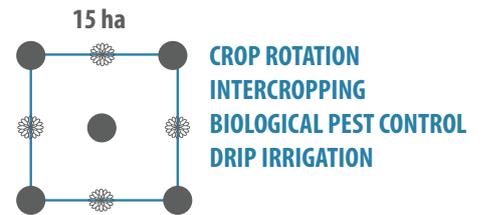
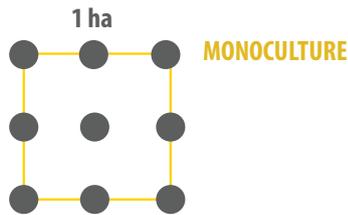
NEW OUTPUTS



New activities



Agriculture methods



Results

- Competitive
- Unfair prices
- Environmental degradation
- Uninformed Consumers
- Human health risk

- Cooperation
- Fair prices
- Preventing environmental degradation
- Creating relationship between producers and consumers
- Improving human health
- New income



AGRICULTURE

Rice

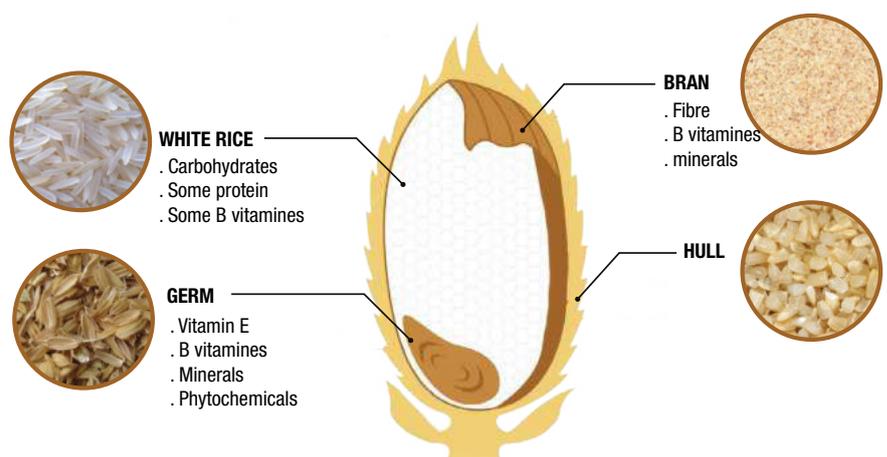


Rice is the seed of the grass species *Oryza sativa*. As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population. It provides two thirds of the calories for most Asians with rice-based diets.

CHARACTERISTICS

Rice is a semi-aquatic annual grass plant. it can grow to 1–1.8 m tall, its yields vary considerably, ranging from 700 to 4,000 kilograms per hectare. The primary requirements of paddy cultivation include a high temperature, humidity and sufficient rainfall with irrigation facilities. It also needs bright sunshine.

The parts of a mature rice seed are illustrated below:



Hull: Each grain of rice is enclosed in a tough outer hull, or husk, that needs to be removed before it can be consumed. Because of its high silica content, it has tremendous potential as an industrial product. Hulls can be used as fuel, fertilizer, poultry bedding and insulation material.

Bran: Bran is the hard outer layers of cereal grain. It is an excellent source of thiamin, niacin, vitamin B-6, iron, phosphorus, magnesium, potassium and fiber. It can be used as animal feed or for enriching bread and cereals.

White Rice: This is the part of the rice that is most commonly consumed. Once the bran and germ layers are removed, white rice remains.

Germ: The germ is only 1% of the total weight but contains 30% of the nutrients. Nutritionally, the germ is 40 times more concentrated in nutrients than the rest of the grain.

HISTORY OF RICE CULTIVATION

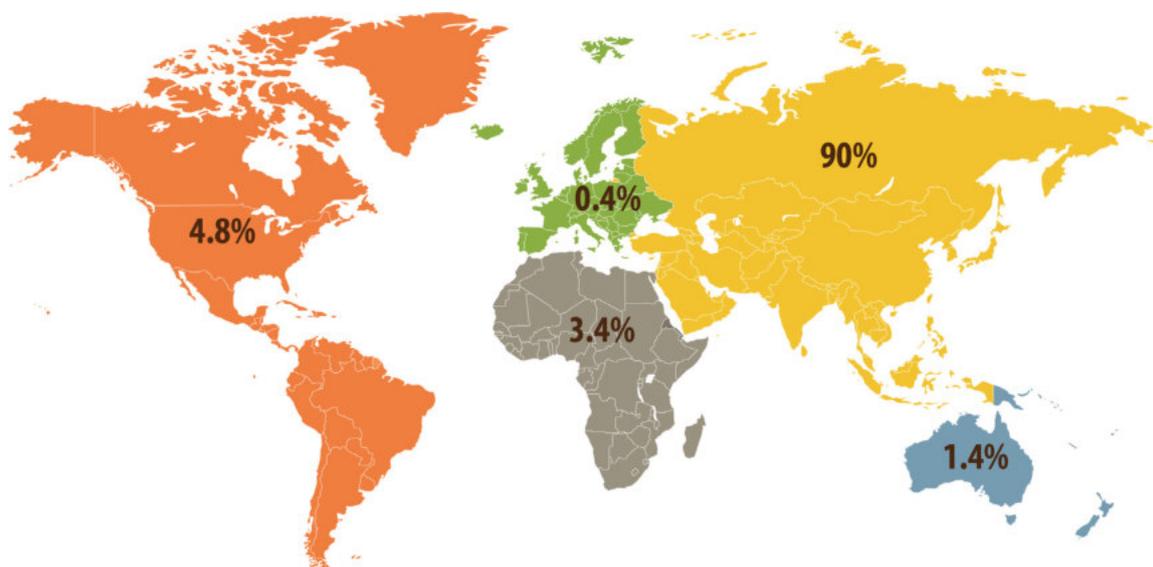
There are many evidence of early rice cultivation in different cultures, including China, India, and the civilizations of Southeast Asia. However, the earliest archaeological evidence comes from central and eastern China and dates to 7000–5000 BC.

Information establishing the precise era in which rice was introduced along the Caspian littoral and on the Iranian plateau does not exist. Some believe that rice was brought to Iran from India for the first time during the Sassanid era (224 to 651 AD). Some also attribute the rice cultivation boom to Arab domination in Iran, and they believe that there was no rice in Iran during the Sassanid era.



RICE CULTIVATION IN WORLD

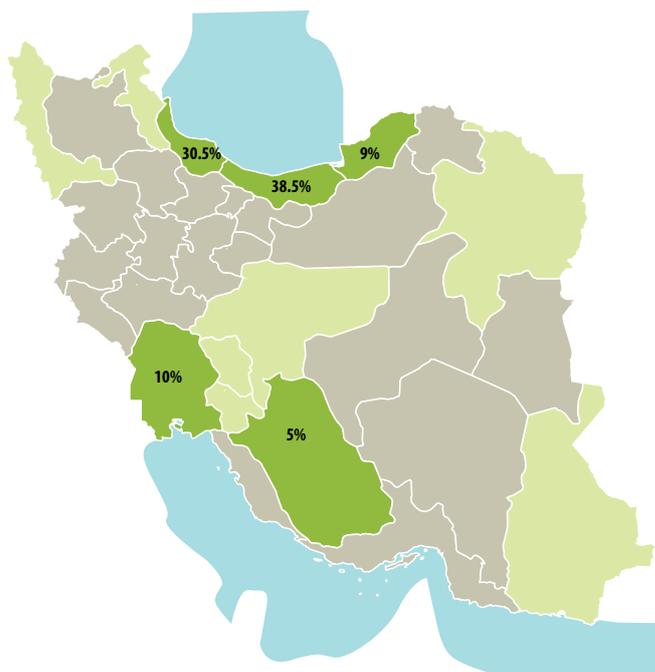
Rice is grown in more than a hundred countries. With a total harvested area of approximately 158 million hectares, producing more than 700 million tons annually. More than 90 percent (Nearly 640 million tons) of the world's rice is grown in Asia, principally in China, India, Indonesia, and Bangladesh.



RICE CULTIVATION IN IRAN

The total area under rice cultivation in Iran is more than 600,000 ha and the annual production is 2,2 million tons.

Rice is grown in 15 provinces; However, due to proper conditions for rice cultivation in the north of Iran more than 80 percent of rice area is distributed in two northern provinces of Mazandaran and Gilan.



IMPORT AND EXPORT



The annual rice consumption in Iran is around 2.8 million tons whereas according to Iran's Ministry of agriculture, Iran's total rice production is about 2.2 million tons per annum. So this level of production is insufficient to satisfy domestic demand and resulting in the importation of about 1 million tons annually. Emirates, Pakistan and Uruguay are the main exporters to Iran.

Imported rice is not comparable to Iranian rice in terms of quality and taste. However, due to their low prices, demand for them has been increased during the last decades that led to a lot of problems for domestic manufacturers.

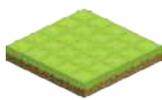
RICE CULTIVATION IN GILAN

As noted before, Gilan is one of the most important rice production regions. On account of the temperate climate, adequate water supplies, and fertile soil, nearly all low-lying, the irrigable land is used for rice cultivation annually.

In the analyzed area nearly 33,000 hectares of agricultural land devoted to rice cultivation. almost all rice is grown on small farms of 0,5-3 ha.



TOTAL AREA OF
RICE CULTIVATION
33.000 ha



AVERAGE OF
RICE FARM
0.6 ha



PADDY YIELD
3.5 ton/ha



RICE YIELD
2.5 ton/ha

Despite the low yields of local varieties, because of their aroma and elongation qualities, more than 80 percent of the total rice is still under these varieties, which are similar to basmati types.

The most popularly grown local varieties are Hasan sarai, Domsiah, Binam, Hasani, Salari, Ambarboo and Sang tarom.



CURRENT RICE CULTIVATION

CULTIVATION SYSTEM

There are two major systems of rice cultivation direct seeded rice and transplanting cultivation systems. In direct seeding, seeds are sown directly in the field. While in transplanting, seedlings are first raised in seedbeds before they are planted in the main field. Almost all rice in this province is grown under irrigated condition.

In the following, the current rice cultivation is explained :

Rice cultivation is categorized into four main steps: pre planting, cultivation, crop maintenance and harvesting.

PRE PLANTING

SEED SELECTION



In Gilan there are more than 200 type of rice varieties; Because of their flavor and taste the farmers are interned to plant them; however there are some types of crops are not cultivated anymore.

During the last years, many rice varieties are modified genetically to be more resistant to pests and diseases and many farmers are encouraged to use them. Unfortunately, they aren't aware of the consequences of these type of seeds.

SEED PRE-GERMINATION



First of all, the seeds must be soaked in the salt solution. In some areas, mollusks use fresh eggs as salt measurements. The ones that float must be discarded while the ones that sink are mature seeds that must be used for planting. Immediately the seeds should be washed after removing from the solution. Then, Farmers soak the seeds in a good fungicide solution like carbendazim for 24 hours. This ensures the seed protection from fungal diseases.

INCUBATION

Then the seeds are put in the sack and placed in the water for 2 to 3 days to absorb enough water. This may take up to a week depending on the ambient temperature. After this time, the seeds are germinated and ready for planting in the treasury.



NURSERY PREPARATION

Prior to transplanting, seedlings need to be raised in a nursery. In preparing the nursery seedbed, the surface needs to be level, free of weeds and well drained. The nursery could be a small piece of mainland or in a piece of land outside the original farm. The nursery is plowed in late autumn, and at the end of the winter is added some manure and chemical fertilizer. Also to control the weed the soil is sprayed with herbicides.



TRANSFERING SEEDS TO NURSERY

The germinated seeds are then sown on the surface and covered with the plastic. During the growth of seedlings again some chemical fertilizers such as urea and super phosphate are added.



CULTIVATION

LAND PREPARATION

Before rice can be planted, the soil should be in the best physical condition. So the field is ploughed and some manures and fertilizers are added, also for clearing the weeds, herbicides are applied to the soil. The whole surface then remained covered with water of about 2.5 cm. The field is then ready for receiving seedlings from the nursery.



TRANSPLANTATION

Transplantation operations begin from early to mid-May. At this time, the seedlings are 20 to 25 centimeters and have 4 to 5 leaves. Seedlings may be transplanted by either machine or hand, but generally, it is carried out by women by hand in Gilan province.



CROP MAINTENANCE

PEST CONTROL

The rice plant can come under threats from different source. These include attack by rodents, insects, weeds and disease.

As the rice is cultivated in a monoculture manner, because of the lack of biological diversity, weeds and insect pests can spread faster, so during the cultivation, the crops are constantly sprayed with chemical pesticides, herbicides and insecticides.

Pests and diseases cause an average of 37% and rodents cause an average of 5–10% loss in rice yield every year.

About 187 species of insects have been recorded on rice, but few have ever become serious pests. The major insect pests of rice are shown below:



Chilo polychrysus



Spodoptera mauritia



Scotinophara coarctata



Nymphula depunctalis



Cnopalocrocis medinalis



Nephotettix virescens



Leptocoris oratorius



Nilaparvata lugens



Sogatella furcifera

In this province, the main pests are Chilo polychrysus, Larvae of the Chilo suppressalis that cause extensive crop losses worldwide.

FERTILIZATION



To achieving the high yield production that is the primary goal of farmers, they utilize an excessive amount of chemical fertilizers. Most of the farmers in this district aren't educated and don't have enough information about the chemical fertilizer. During the last years, many paddy fields in this area are faced with the eutrophication problem that is associated with fertilizer application. This problem has encountered farmers many problems.

HARVEST

A rice crop usually reaches maturity at around 105–150 days after crop establishment. And the process of collecting the mature rice crop begins. Harvesting activities include cutting, stacking, handling, threshing, cleaning, and hauling.

Before harvesting, Irrigation of the field is completely stopped. This dehydration process helps in grain ripening. It also hastens maturity.



POST HARVEST

After harvest, the rice grain undergoes a number of processes depending on how it will be used. These steps include drying, storing, milling, and final processing.

DRYING

Drying is the process that reduces grain moisture content to a safe level for storage. When rice is harvested, it will contain up to 25% moisture. That can lead to grain discoloration, encourage the development of molds, and increase the likelihood of attack from pests.



THRESHING

Threshing involves separating the grains from the straw either by impact, friction or combing action.

Because of high labor requirement of manual threshing stationary threshers of different types and sizes are increasingly being used.



STORAGE

Proper storage conditions will ensure minimal loss of paddy rice due to changes in weather and moisture content, rodents, insects, microorganisms etc.

MILLING

Milling is a crucial step in the post-production of rice. The basic objective of a rice milling system is to remove the husk and the bran layers, and produce an edible, white or brown rice kernel that is sufficiently milled and free of impurities.



OUTPUT ANALYSIS

RICE

Rice that is produced in this way doesn't have enough quality and is contaminated. In fact, chemical residues may generally remain in a crop or its produce for a period of time and can pose a risk to public health.

WATER

Drained water from paddy fields is extremely contaminated because of the excessive use of chemical compounds. Contaminated water can be a threat to the ecosystem. When excess nutrients from fertilizers leach into rivers or wetlands, they stimulate the growth of algae. This increased aquatic plant life can produce floating surface scum known as algal blooms. When algal blooms form, less sunlight can penetrate the water surface, which results in decreased productivity of underwater plants and depleted oxygen reserves. The lack of oxygen has devastating effects on aquatic life, including fish. In addition, some algae produce toxins in the water, further damaging the aquatic ecosystem.

In the last decades, Azolla entered Anzali lagoon by water flows from paddy fields, spreading over the lake. It reduced sunlight penetration to the water and led to the drying of the lake. In consequence, aquatic animals and plants are exposed to danger.

ORGANIC WASTE

After harvesting in many parts, farmers burn rice husk. The problem with burning rice husk is that it poses health and environmental hazards. As mentioned, they have nutrients and they can be used in other activities and can generate additional income for farmers.

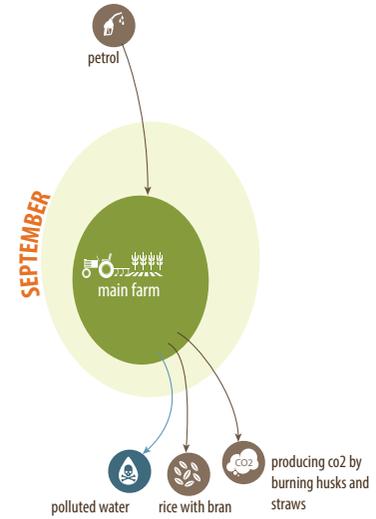
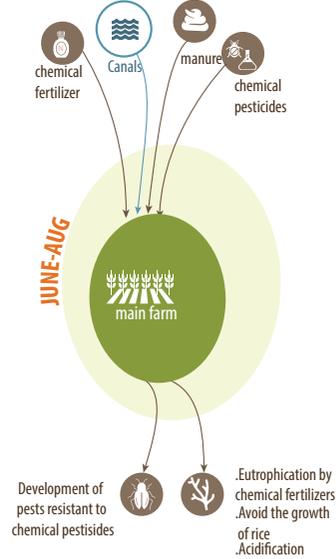
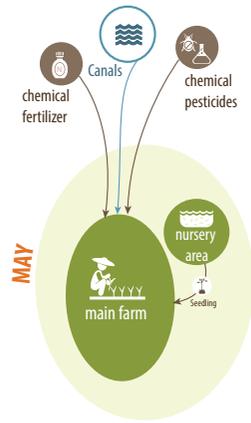
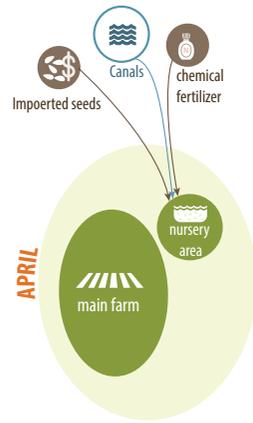
INORGANIC WASTE

Many inorganic wastes from packaging or other processes are thrown out, generating adverse effects on the environment of the agro-ecosystem.

RICE CULTIVATION PROCESS

CURRENT

SPRING & SUMMER



AUTUMN & WINTER

The farm not be used for six months



Resource	Natal water resources	Water depletion
	Petrol	Non renewable energy

Inputs	GMO seeds	Increase herbicide Soil contamination Loss biodiversity	
	Chemical fertilizer	Soil acidification Soil contamination water contamination Eutrophication	
	Chemical pesticides	Loss biodiversity Threaten human health Insecticide resistance	Soil contamination Water contamination Air Pollution
	Contaminated manure	Soil contamination Water contamination	

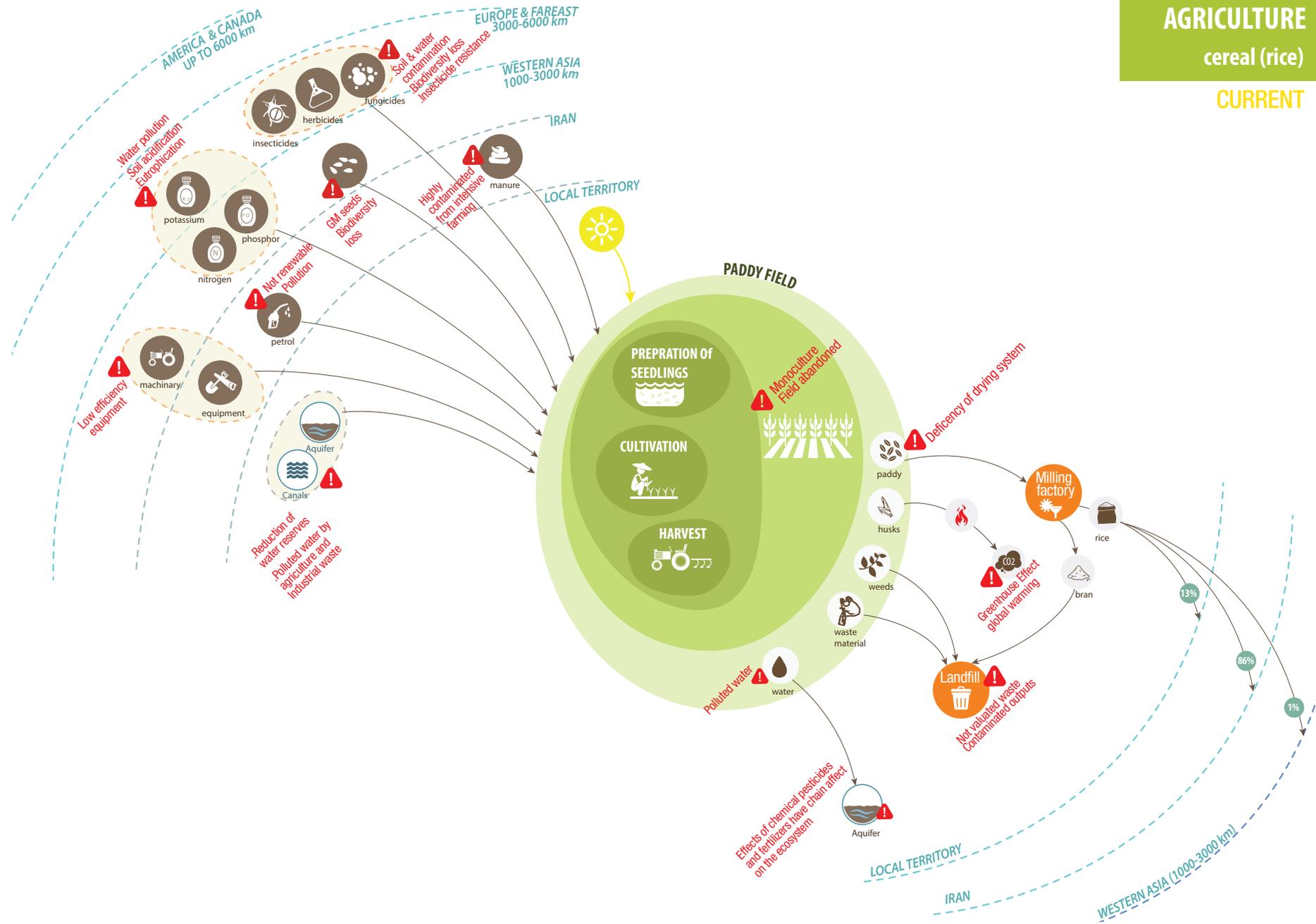
Outputs	Paddy	Contaminated with chemical residue threaten human health
	Husk & Straw	Not valuated
	Packaging waste	Non recyclable Environmental pollution
	Gray water	Eutrophication Threatened aquatic species Water depletion

Agriculture methods	 1 ha Monoculture	Soil Degradation Changing Organism Resistance High use of water High use of pesticides Loss of biodiversity Field abandoned
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AGRICULTURE

cereal (rice)

CURRENT



SYSTEMIC RICE CULTIVATION

In order to decrease the environmental footprint of the current rice cultivation and improve the quality of the rice, rice farming needs to be managed in a sustainable way. It's important to mention that rice farming produces 10% of global methane emissions and requires 34-43% of the world's irrigation water. In order to decrease water use, soil pollution, and methane emissions, as well as improve their yields, farmers need to embrace sustainable farm practices.

Integrated rice farming and integrated pest management strategies provide sustainable options to rice farming, because of a more balanced use of multiple ecosystem services that benefit the farmers' health, economy and the environment.

INTEGRATED FARMING



Integrated rice farming means raising rice at the same time and place with different types of animals that can be raised in paddy fields. Using biodiversity methods in rice farming have many benefits, including greater yields, pest and weed control, disease resistance, increased nitrogen efficiency and reduced output of greenhouse gases. It improves diversification, intensification, productivity, profitability, and sustainability. It can also optimize resource utilization through the complementary use of land and water.

INTEGRATED RICE –DUCK-FISH



Growing up rice, fishes and ducks at the same time in paddies is an excellent example of integrated rice cultivation.

In the systems, ducklings and fish are released in flooded rice fields, growing alongside the rice plants and eventually providing a source of food. Ducks eat many broad leaf weeds of rice and, through their walking and swimming, reduce germination of weed seeds. Ducks also eat insects including the rice

planthopper pest. By controlling pest and weed populations, the ducks reduce the incidence of rice diseases including sheath blight and stripe.

In this system, duck sheds are constructed over the fish pond refuge that is contiguous to the rice field. The floor of the duck house has some spaces to allow the manure and spilled feed to fall directly into the fish pond. The duck manure serves as an organic fertilizer for plankton production while the spilled feed can be directly consumed by the fish. Nutrients from the fish pond refuge are dispersed to the rice fields by irrigation water or by the movement of fish and ducks.



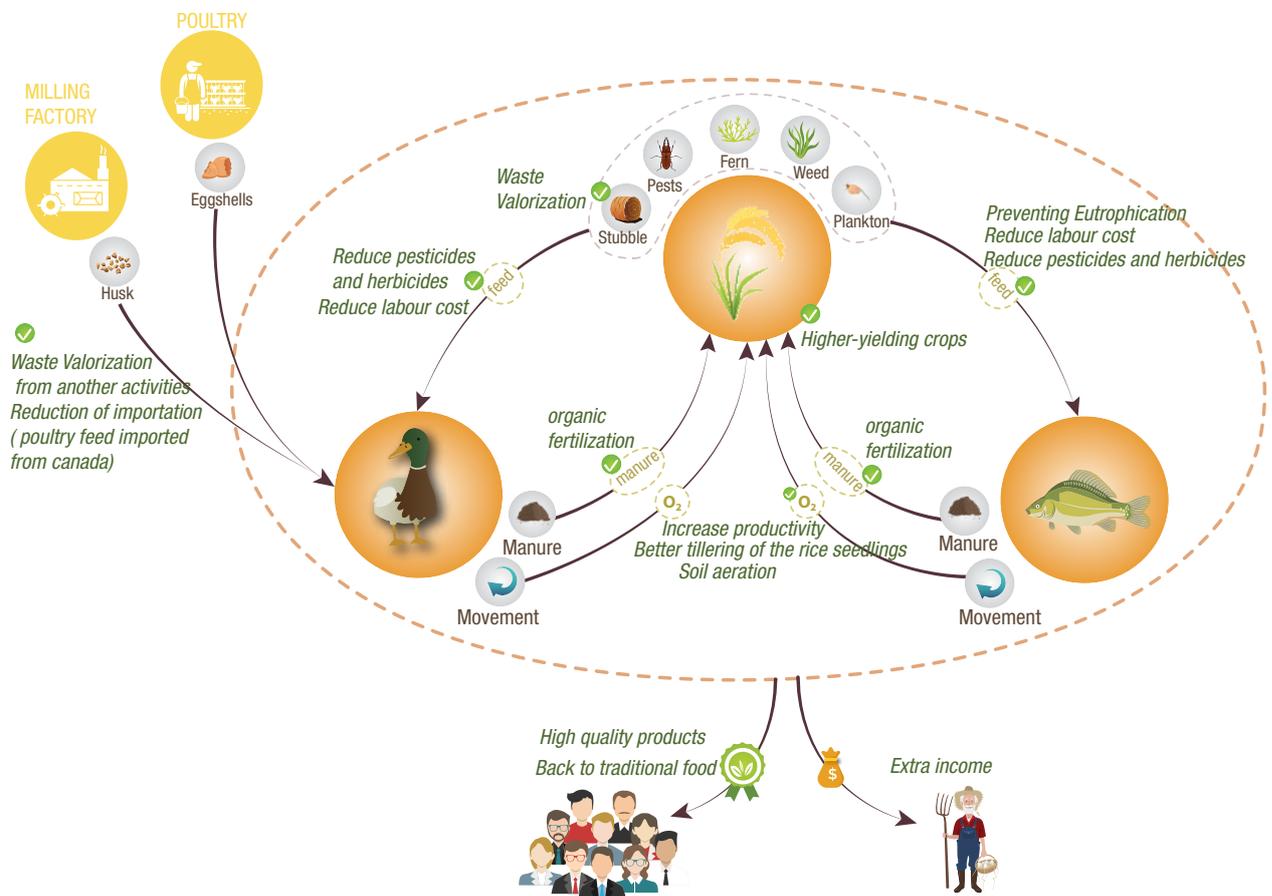
For implementing, ten days after transplanting the seedlings to paddy fields, 20-day-old ducklings are released in the plots at the rate of 350–400 birds per ha. At the onset of rice flowering and when the ducklings, upon reaching four months old, they are removed from the rice fields to prevent damage to the rice. These ducklings can be either sold or either confined or allowed to move around the rice fields until rice harvest and after rice harvest, they can be herded into the paddy fields.

During confinement, ducks are fed with supplemental feed. Sometimes it may be necessary to use supplemental feed even when feeding in the paddy fields because of insufficient nutrients.

In the same way after cultivation of seedlings, 1000 fingerlings fish are released in paddy field also a fish sump need to be provided as hiding place for fish during the season of shallow irrigation and high temperature, or when the field is drained. The fish species which could be cultured in rice fields must be capable of tolerating shallow water, high temperature, low dissolved oxygen and high turbidity.

common carp, grass carp, silver carp and big head carp are some of the fishes that can be used for integrated rice farming.

The scheme below shows all benefits that can be derived from this system:



A normal rice farm would require significant human labor to keep weeds down and maintain soil health, but the ducklings' natural movement aerates the soil and strengthens rice stalks. The reduction of human effort supported by the process allows farmers to diversify their product base to include organic rice, fish, duck meat and eggs, thus reducing their vulnerability to external shocks such as price fluctuations, and potentially creating price premiums from attractive organic food markets.

CROP ROTATION

Before harvesting, water is drained off from the paddy-field surface, however much of the water is retained by the soil even after rice harvest. This wet soil profile has the potential to become an extra economic resource for farmers to grow another crop during winter straight after rice.

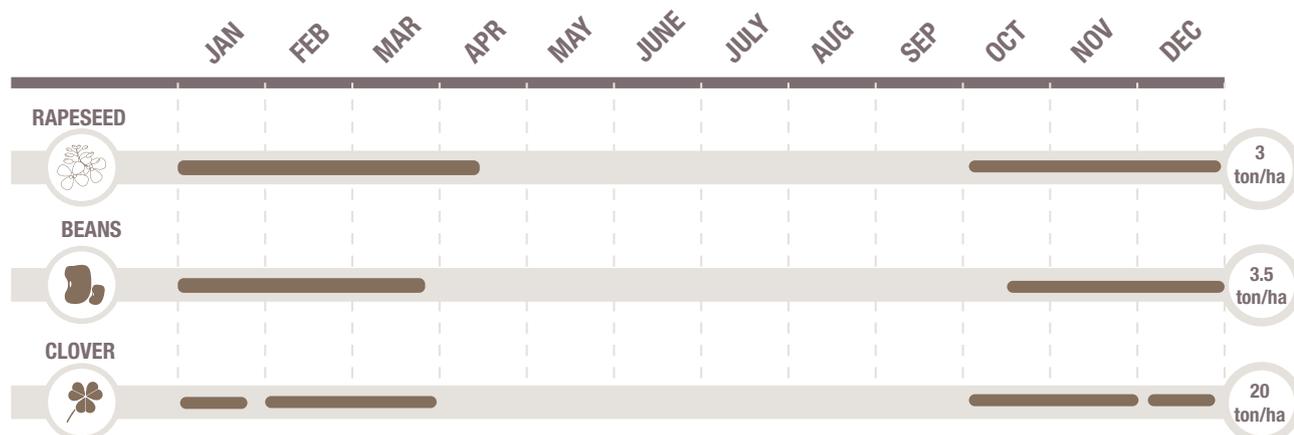
Unfortunately as shown before, the farmers of this area leave the field abandoned after harvesting the main crop for 5 months.

In these circumstances, crop rotation can be a good solution for intensifying and sustainable rice production.

Selecting the proper crop is very important, continuous rice planting reduce s soil nitrogen supply and organic carbon content. So nitrogen fixing crops can be ideal for crop rotation in paddy fields.

Legumes such as mung beans, cowpea and soybeans and clover are some of the best crops that can be cultivated in rotation with rice. legumes are nitrogen-fixing plants, which add fertility to the soil that are quite beneficial to rice.

Another crop that can be used as a rotational crop is rapeseed, It helps to control weeds, diseases and pests by breaking their life cycles. Rapeseed have greater biomass and organic materials, which may have more favorable effects on soil amendments and rice growth.



BIOLOGICAL CONTROL



Biological control is the regulation of pest populations by the activity of natural enemies predators, parasitoids and pathogens.

Green muscardine fungus, *Trichogramma*, *Lycosa pseudoannulata*, *Cnaphalocrocis medinalis* are some species of predators, parasitoids and pathogens that attack to the eggs, larvae and pupae of rice's pest and play an important role in the regulation in rice insect pest populations.

Among all this, *Trichogramma* is the most used biological control. Using *Trichogramma* species is very effective and give significant results.

GREEN MANURE



Green manure is another farming practice that leads to an increase of nitrogen and organic nitrogen in the soil and subsequent crop growth.

Green manure crops are cultivated up to 50% flowering stage and ploughed back into the soil. They usually cultivated for about 45 days and it takes another 10 days to get decomposed into organic matter.

Sesbania is the common green manure crops. it is a fast-growing legume with nitrogen-fixing nodules on its stem and roots.

VALUATED OUTPUT

RICE STRAW



Rice straw can be utilized as the main ingredient of compost fertilizer. Although organic fertilizers, including rice compost, are often low in major nutrients such as nitrogen and phosphorus, they can be highly beneficial because they contain micronutrients, enzymes and micro-organisms that are often not found in inorganic fertilizers.



Apart from that, they are ideal for a wide range of products including paper, building materials, textiles and other fiber-based products.

In addition, as mentioned before, rice straw is the raw material for hasirbafi art that is one of the endangered handcraft. Dedicating apart of these waste to hasirbafi can help and revive this handcraft.

WEED

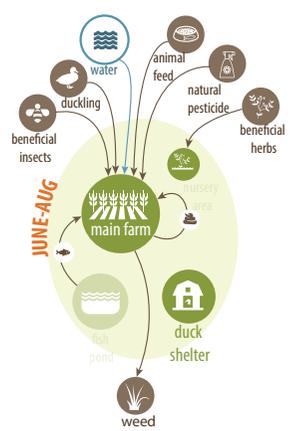
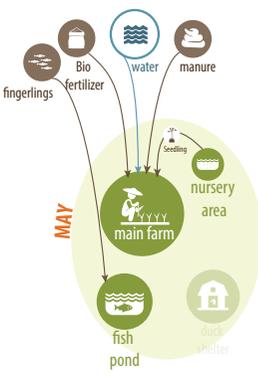
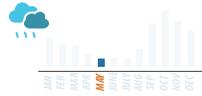
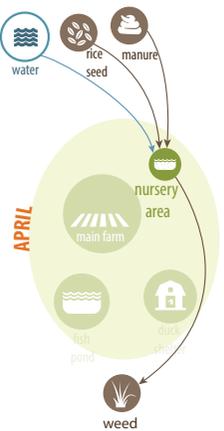
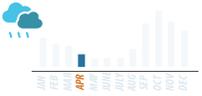
Weeds are useful for the soil as organic manure. Instead of throwing the weeds, they could be used for composting. The compost can be used as an organic fertilizer, and as a soil conditioner on farms.

Applying these practices to paddy field has multidimensional consequences in the long run. Their environmental impacts are no chemical contamination, a balanced agroecological system, and preservation of natural resources and production systems compatible with the environment. Social impacts include food security and safety, the provision of local needs and empowerment of households particularly women and the application of practices compatible with indigenous and local knowledge. Economic impacts are raising income, economic security, the production of safe food and the reduction in application of external inputs.

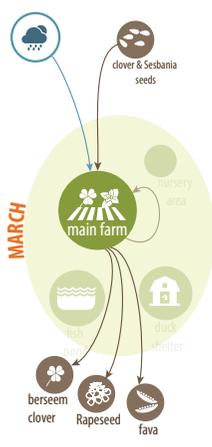
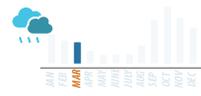
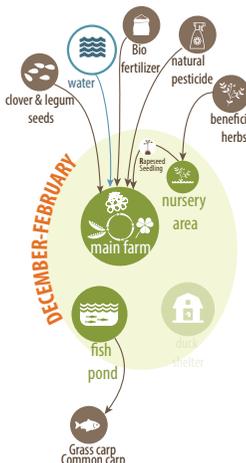
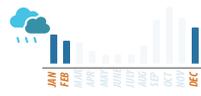
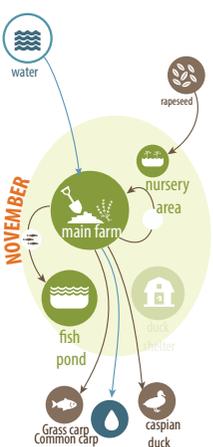
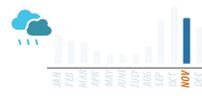
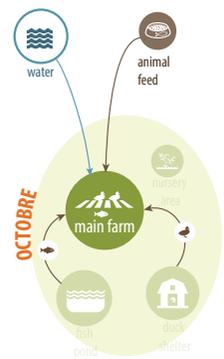
RICE CULTIVATION PROCESS SYSTEMIC

SYSTEMIC

SPRING & SUMMER



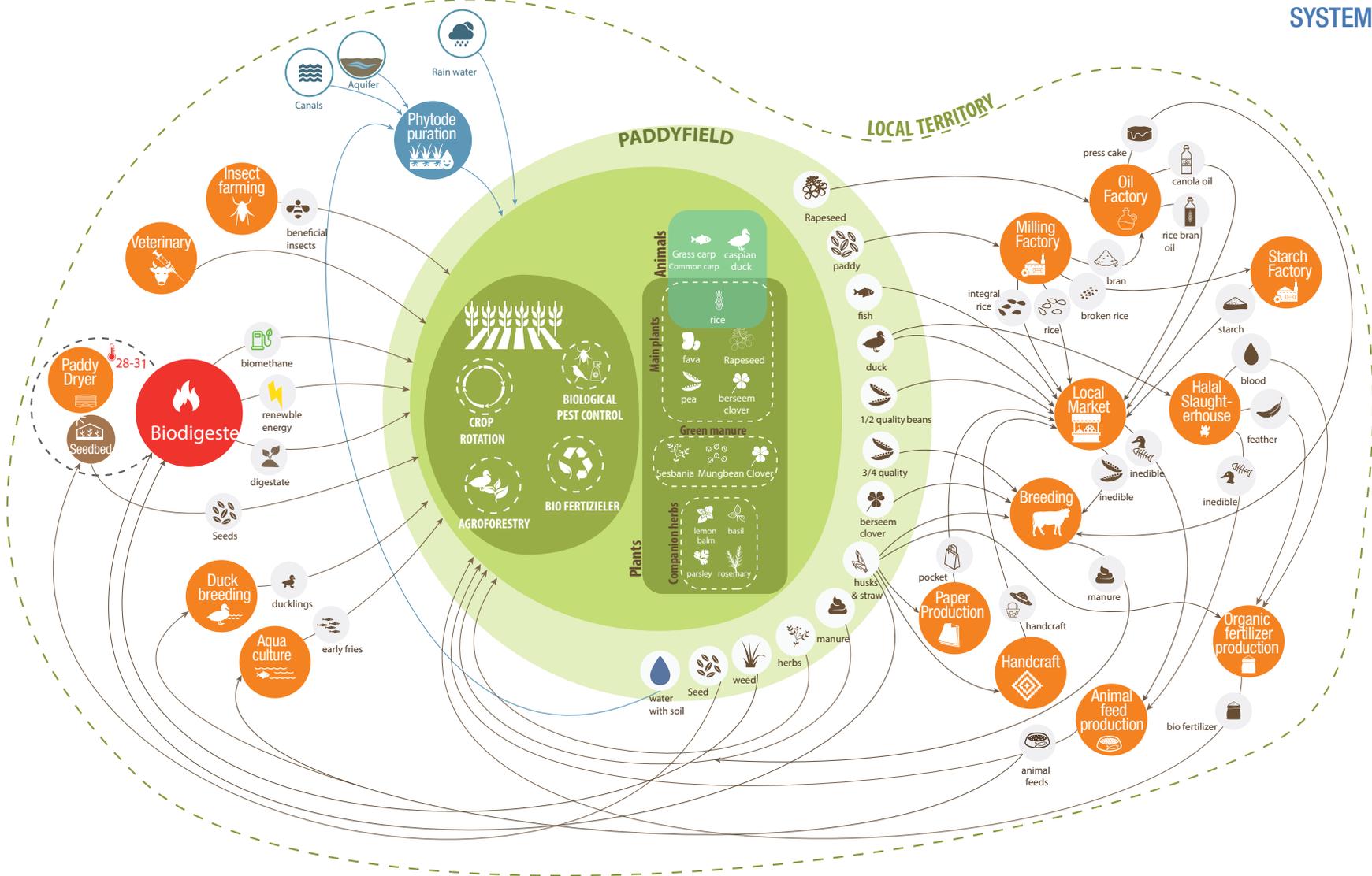
AUTUMN & WINTER



AGRICULTURE

cereals(rice)

SYSTEMIC



CURRENT

SYSTEMIC

Resource



Energy from net

Renewable energy from biodigester or wind turbine



Natural water resources

Water from phytodepuration



Petrol

Biomethane from biodigester



Inputs



GMO seeds

Organic seeds



Chemical fertilizer

Digestate from biodigester
Green manure



Chemical pesticides

Biological pest control
Biopesticides



Contaminated manure

Manure from local farms



Outputs



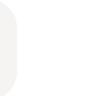
Husk & Straw



Branch leaves



Breeding



Packaging Non recyclable



Packaging recyclable



Gray water



Gray water



Fish & duck



Rapeseed



1/2 quality vegetables



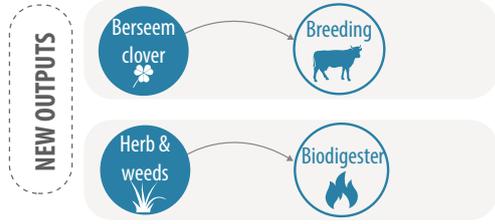
3/4 quality vegetables



NEW OUTPUTS

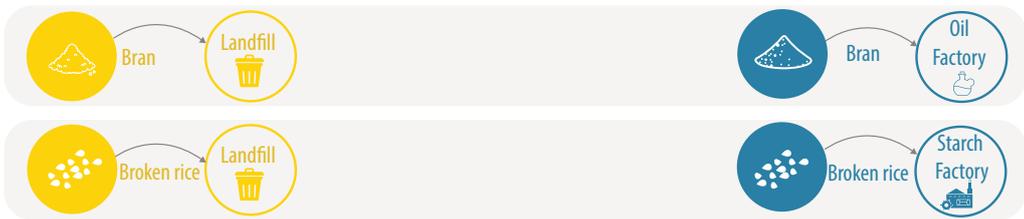
CURRENT

SYSTEMIC

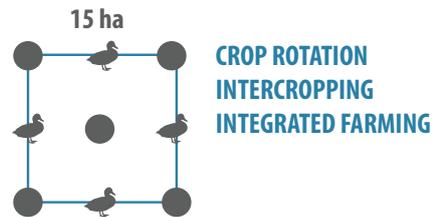
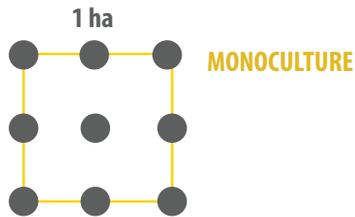


process phases

Outputs



Agriculture methods



Results





TREE FARMING

populus and mulberry

POPULUS FARMING

Iran is a Low forest cover country, its forests cover only less than 10% of its total land area.

Iran's forest can be divided into five vegetative regions. Hyrcanian forests, Arasbaran forest, Zagros natural forests, Irano-Touranian central forests, tropical and arid forests along the Persian Gulf.

The Caspian Hyrcanian forests are located in the southern shores of the Caspian Sea and cover 1.2 million ha of land area.

The Hyrcanian forests are one of the last remnants of natural deciduous forests in the world. They are suitable habitats for a variety of hardwood species such as beech, hornbeam, oak, maple, alder, and other forest tree species including 80 woody species.

These forests are known as one of the most basic resources for wood production and have an important role in supplying of raw materials for wood industry. However, In recent years overexploitation the trees make these forests in danger of destruction.



One of the main approaches for protecting forest is the development of tree plantations in prone areas. Establishment of large-scale short-rotation woody crop plantations has been advocated as an effective method for this purpose.

Poplar as a fast-growing species planting is an appropriate option to provide a reliable wood supply and also as an energy resource.



POPULUS

Populus is one of the most basic resources for wood production and has an important role in supplying of raw materials for wood industry. They are known as “the trees of the people”.

Populus tree grows mostly in temperate climates. It requires enough moisture, direct sunlight and soil rich in nutrients. It can grow from 5 to 10 feet per year depending on the variety and location.

They have many valuable characteristics which have led to multiple beneficial uses for society and the environment. Today, poplar uses are expanding to provide environmental benefits such as phytoremediation, soil carbon sequestration, reduction in sediment run-off, improvement in soil quality, and habitat for wildlife. Some argue that poplars can be an important component of solving twenty-first century economic and environmental problems.



POPULUS CULTIVATION IN SOMEH SARAH

Poplar is an indigenous plant of this province and poplar plantations cover some 10,000 ha in this area. This province is known as the largest wood harvesting area in Iran. In other words, more than 11% of the total poplar industry in the country belongs to this area.

Poplar clones planted are limited to acclimatized exotic species specifically, *Populus deltoides* and *populus euramericana* clones. These types were imported from Italy, Germany, Turkey, Netherland countries from 1965 to 1970 when Iran became a member of IPC1 in 1953. However, *Populus caspica* which is an indigenous spice of this area aren't cultivated anymore and are endangered.



CURRENT TREE FARMING

The practices carried out by farms to obtain the timber harvest at the end of the production cycle are explained below:

PLANTING

The best season for planting poplar is at the beginning of April. The planting time is very important; has led to much dieback due to frost and freezes. The Seedlings should be planted when the soil is moist or when rain is expected.



The first consideration is the preparation of the land. The Land should be ploughed a couple of times to make weed free then some herbicides are sprayed before planting.

Planting consists of 2 steps: Growing tree seedlings in the nursery and then transferring them to the mainland.



After moving from nursery to main field Young plants are treated with chemicals and fungicides to protect from pests and diseases.

FERTILIZING

Poplars have a high nutrient requirement to maintain maximum productivity. It accelerates the growth of poplar and reduces the age of exploitation.



Generally, chemical fertilizers and manure are applied before planting with plowing and after planting. However Using chemical fertilizers for a prolonged period of time upsets the pH of the soil, causes an increase in pests and does away with the beneficial microbes present in the soil.

Typical formulations currently used are:

200-300 kg/ha of Nitrogen

120 kg/ha phosphorus (P2O5)

250 kg/ha of potassium (K2O)

WEED CONTROL

If the weeds are not controlled, they affect the growth of seedlings, especially during the first and second years. Mostly farmers adopt chemical herbicides or mechanical methods for weed control.

PEST CONTROL

Many insects and diseases can threaten the success of poplar plantations by reducing productivity and/or quality of affected trees. They either kill trees or prevent them from reaching their potential growth. To control the pests farmers use chemical pesticides to protect their trees.

When pesticides are applied by dispersion, it falls in every part of the plant, including leaves, branches, and trunk. Consequently, the poisonous substances reach animals, insects, even bees who pollinate. The poison also reaches the surroundings, contaminating the soil, water, and even the air.

There are hundreds of insects that attack poplar leaves and stems, but the common insects found in this area are shown below :



PRUNING

Pruning is the removal of lower dead or dying branches to enhance stem wood quality. Pruning is usually done in late spring or early summer so wounds can heal. Pruning can be done by hand with pruners or by using hydraulic pruners.



HARVEST

Poplar stands should be harvested when their average annual growth increment begins to decline over time. This time frame depends upon the original planting spacing and growing conditions. Poplars should be harvested in the winter months (November to April) to minimize soil compaction and to maximize resprouting.



OUTPUT

TIMBER

Growth and yield of poplars depends upon climate, site quality, clone, age, spacing and treatments, but in average, yields of about 25 m³ /ha can be attained within four years poplars plantations.

Despite the proper cultivation conditions, Unfortunately, the lack of sufficient knowledge of farmers, Inappropriate agricultural machinery and equipments, unsustainable farming practices have led to a reduction in the productivity of this product in comparison with other countries.

ORGANIC WASTE

Many organic waste such as leaves, branches, and trunk are produced during different steps of cultivation. However they are contaminated with chemicals that applied during the cultivation. If these waste enter to the soil, they can affect to the quality of the soil, consequently after leaking into the soil, eventually flows through the ground and make the groundwater contaminated.

INORGANIC WASTE

Many inorganic waste from the packaging of chemical products or other process is generated.

MULBERRY FARMING

Morus alba, known as white mulberry, is a fast-growing deciduous woody perennial with a deep root system. Mulberry trees are either dioecious or monoecious, and a tree sometimes will change from one sex to another.

Mulberries are fast-growing when young, but soon become slow-growing and rarely exceed 10–15 meters (30–50 ft) tall.

Mulberry foliage is the only food for the silkworm (*Bombyx mori*). Its leaf is a major economic component in sericulture since the quality and quantity of leaf produced per unit area have a direct bearing on cocoon harvest.



SERICULTURE

Sericulture, or silk farming, is an important cottage industry for the production of raw silk through the rearing of the silkworm. The industry is particularly suitable for because of its low investment and the short gestation period.

SERICULTURE IN IRAN

The cultivation of the silkworm spread to Iran toward the end of the Sasanian period (around the 6th century A.D.). During the Sassanian era, in the 5th and 6th century AD, silk production was a booming business in Iran. Historical accounts reveal that for centuries, silkworm rearing was a lucrative business in many agricultural regions in Iran. The shiny soft silk of Gilan was mainly shipped to European markets.



Gilan and Mazandaran were the major silk producing regions due to the region's suitability for mulberry tree plantation. Information accumulated by a former British foreign secretary confirms that the silk output of Gilan alone stood at 1,300 tones in the 17th century. But this upsurge in silk production was interrupted by the ravages of pebrine (a disease of caterpillars) which appeared in Europe in 1845 and spread to Iran in the 1860s.

Today Gilan remains the principal region for sericulture, supplying about 50 percent of the national production.



Even though sericulture is viewed as an economic activity, the practice is vanishing from many villages due mainly to lack of training for the villagers and use of traditional, inefficient methods. Silkworm farmers in Iran still follow old cultivation methods with age-old and low-yielding mulberry varieties.

Disappearing of this practice has affected widely on the cultivation of mulberries. During the last decades, many farms that are dedicated to mulberry cultivation have turned to other crops.



MULBERRY CULTIVATION

In the selected zone nearly 480 ha is devoted to mulberry cultivation in which every hectare of a mulberry garden can produce 28 tones of leaves.

As all planting steps of mulberry cultivation include land preparation, planting, fertilizing and pest control until harvesting are the same as populus cultivation and consequently, either created problems; In this part, only harvesting of mulberry are explained.

Picking of leaves should be carried out when the leaves are at the correct stage of maturity for harvest. Otherwise, part of the leaves will become over mature coarse and suffer in quality from the point of view of nutritive value for the silkworms. Also part of the leaves may turn yellow, shed and be lost. Therefore, timely harvest, as the leaves reach the required stage of maturity, will lead to a fuller harvest of the available leaves without wastage, and realization of maximum yield. It is preferable to harvest the leaves during morning hours. There are three methods of harvesting of mulberry leaves; the first one is leaf picking in which individual leaves are harvested with or without a petiole, the second one is branch cutting that the entire branches are cut and fed to the worms and finally whole shoot harvest that the branches are cut at ground level by bottom pruning.

The growth and development of silkworm are greatly influenced by the quality of mulberry leaf. Chemical fertilizers and pesticides that are applied during the cultivation have negative impacts on leaf yield, quality and cocoon productivity.





Resource



Energy

Non renewable energy



Water

Water depletion
water contamination



Petrol

Non renewable energy

Inputs



Seedings

Non native species
Loss biodiversity



Chemical fertilizer

Soil contamination
water contamination
Eutrophication



Chemical pesticides

Loss biodiversity
Threaten human
health

Soil contamination
Water contamination
Air Pollution



Manure from
intensive farm

Soil contamination
Water contamination

Outputs



Contaminated tree

Threaten birds & insects



Conaminated foliage

Threaten animals
Soil contamination



Non-renewable
waste

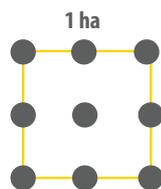
Non recyclable
Environmental pollution



Gray
water

Ground wate
contamination

Agriculture methods

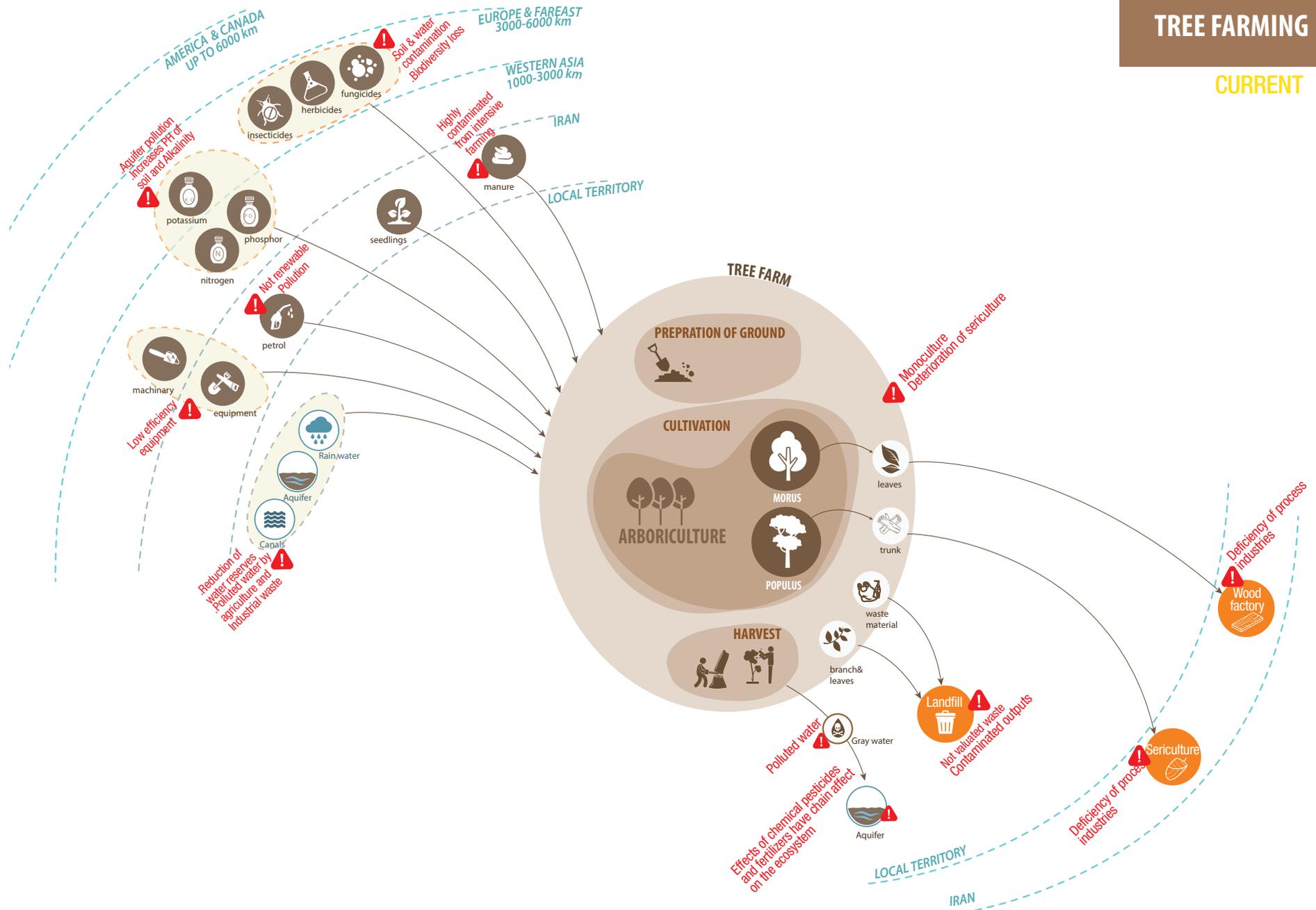


Monoculture

Soil Degradation
Changing Organism Resistance
High use of fertilisers
High use od pesticides
Loss of biodiversity

TREE FARMING

CURRENT



SYSTEMIC TREE FARMING

POPULUS

By implementing sustainable methods of farming we will be able to guarantee the outputs of the system, Which then becomes the inputs of other systems.

Organic farming employs biological methods and techniques to eliminate the problems that conventional systems create. Organic poplar farmers rely on rotation of crops with trees, shelterbelts for livestock shelter, intercropping of poplars and agronomic and horticultural crops, green manure for building soil organic matter, livestock manure and composting for fertilizer, and cultivation for weed control.

AGROFORESTRY

Agroforestry is a land use management system in which trees or shrubs are grown around or among crops or pasture land. It combines shrubs and trees in agricultural and forestry technologies to create more diverse, productive, profitable, healthy, ecologically sound, and sustainable land-use systems.

Agrisilvicultural and Silvopastoral are two main types of agroforestry systems:

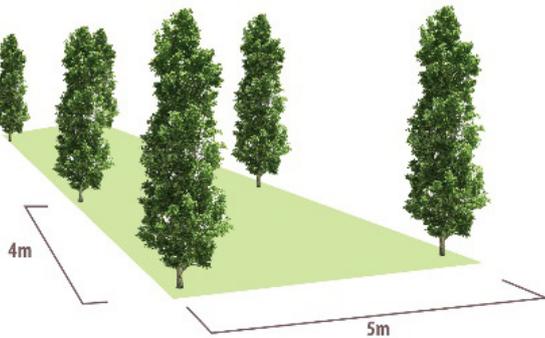
AGRISILVICULTURAL



Agrisilviculture means growing crops and trees on the same piece of land simultaneously. Populus trees could be a good choice for this systems because it has little shading effect on crops also it adds to soil fertility through its leaf litter; further a wide variety of commonly planted crops can be grown as intercrops.

Tree-based intercropping is considered to be a potentially useful land use system for mitigating negative environmental impacts from intensive agriculture such as nutrient leaching and greenhouse gas emissions. Intercropping provides certain environmental benefits and enrich the soil through nutrient pumping from the deep profile, return of litter and reduce soil erosion.

For intercropping, there should be enough space between trees, so in the first step, the poplar seedlings should be cultivated in the proper distance. Generally, the spacing of 5 x 4 m is appropriate for crop yield and tree productivity.



The success of the intercropping system depends on the selection of appropriate species. So the next step is providing the best crops for intercropping.

During the first two years, sugarcane, sorghum, soybean are the best crop for intercropping with poplar trees.

Over the next two or three years, other crops such as barley, wheat, clover, peas, corn, beans, melons, oats, potatoes, rye, sugar beets, sunflowers, vegetables, and fruit trees (citrus, guava,..) can be intercropped with poplars. However, the most common and successful is intercropping poplar with winter wheat and Lucerne.

In the subsequent years when the poplar becomes larger due to the shade of the trees, only shade-loving crops like turmeric and ginger and Lucerne can be cultivated.

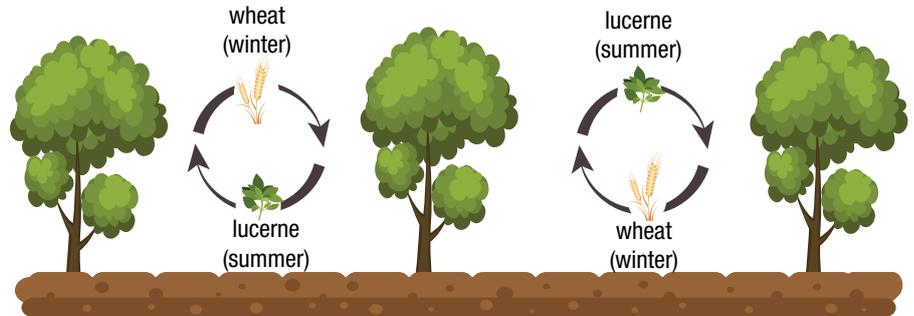
All these crops intercropped with poplar serve a dual purpose in that they have reasonable yields while at the same time controlling weeds and building organic matter as a green manure crop.



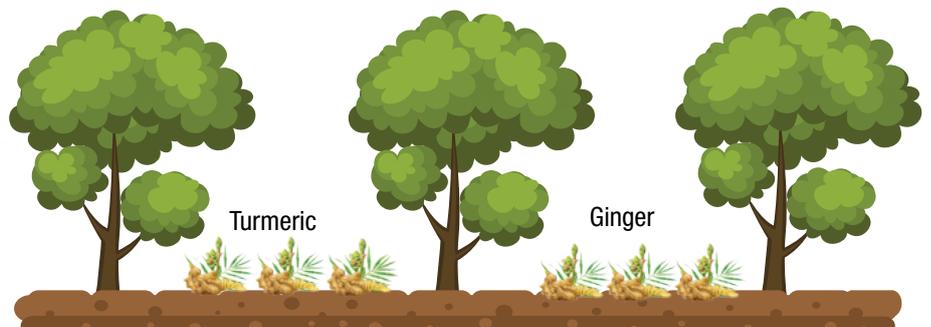
In initial years



Over the next two or three years



After fourth year



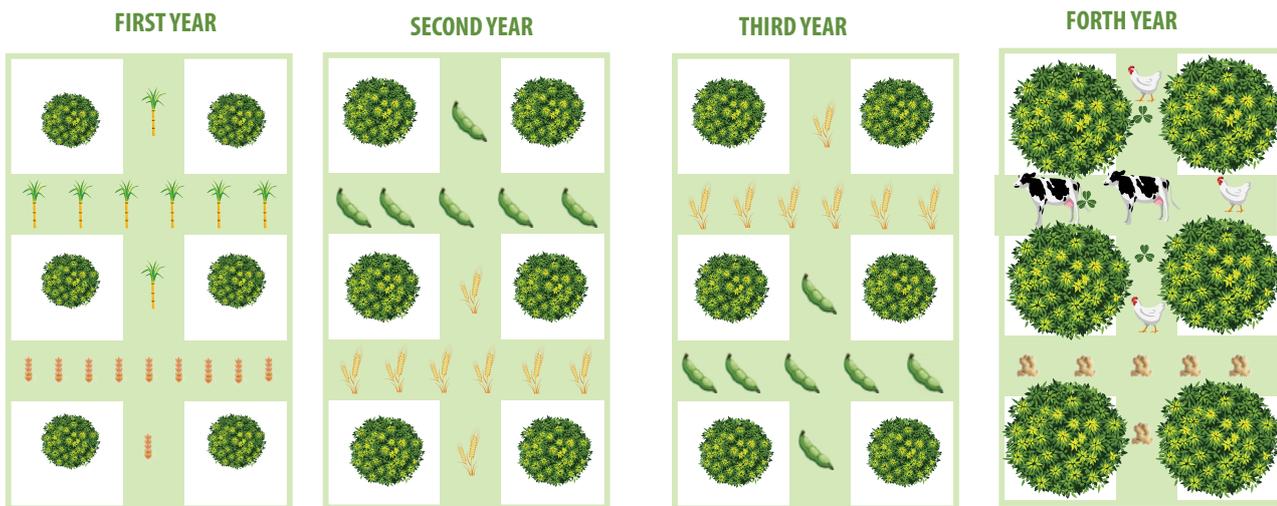
SILVOPASTORAL SYSTEM



Silvopastoral systems are a prototype of agroforestry with a livestock component. As mentioned in the livestock sector. This area is suffering from a shortage of pasture, While poplar fields can be a good place to graze livestock.

This practice provides mutual benefits for poplars and animals. The animals are benefited by the shelter provided by the poplars during the summer and the winter, and the trees are benefited by the weed control provided by animal grazing and fertilized by their manure.

The best time to transport livestock is when the poplars are more than 4 years old because the possibility of damaging trees by animals is minimized also as mentioned before, one of the crops that is cultivated during this time is lucerne which is a useful source of protein for feeding to cattle, so it could lead to increases production efficiencies such as daily milk yields of dairy cattle, as well as weight gains on cattle and poultry.



MULCHING

Mulching is an effective weed control method. Mulch provides a form of insulation that protects the tree from heat and cold temperatures. Mulching also helps to retain water and ensure the roots of the tree remain moist. By adding mulch around the trees, you keep weeds out and therefore avoid root competition that can hinder the tree's growth.

Adding mulch around newly planted trees can also help to keep fungal spores and other diseases from getting to your tree. Many materials can be used for mulch such as sawdust, wood chips and bark.



PEST CONTROL

It may not be necessary to control pests if numbers are low and damage is not significant. At other times, simply spraying a tree with water, pruning a branch or digging up a weed will reduce or eliminate the problem. Natural predators may also control the pest problem.

Biological controls are natural enemies of pests such as predatory and parasitic insects as well as birds. These natural enemies will often come to the garden on their own if there are high populations of a pest insect. The most common beneficial insects are lady beetles and praying mantids.

Planting some flowers such as marigold or Chrysanthemums in and amongst the fame is one of the best ways to encourage good bugs



PRUNING



On the farm, it is nearly always the case that using the best tools for a job will produce the best results, and this is the general rule when it comes to selecting poplar. To manage poplar effectively, a landowner should use the appropriate equipment and be adequately trained in tree pruning and felling operations.

Pruning of lower branches second year onwards not only benefits the trees but intercultivated crops as well through the increased value of large clear bole and penetration of more relative illumination, respectively.

COPPICING



Coppicing is an ancient form of woodland management, that involves repetitive felling on the same stump, near to ground level, and allowing the shoots to regrow from that main stump . After 8-15 years, these are then harvested, restarting the cycle once more. It is a highly effective and inexpensive method of producing a great deal of fast growing, sustainable timber without the need to replant.

Cropping the populus trees should be done in the dormant season.

OUTPUT MANAGEMENT

In new system, by implementing new activities, new high-quality products are generated that could be sold directly or transferred to local markets.

In addition The foliage generated from poplars or other activities that are rich in nitrogen and protein, can be used for animal feed or as mentioned before for making organic fertilizer such as vermicompost or digestate.

MULBERRY

The quality of mulberry leaf has a great influence on the growth and development of silkworms. Feeding silkworm with high quality mulberry leaves during their entire growth (1st - 5th stages) caused lowest percentage mortality and percentage bad cocoon and ensure them for having a healthy growth of silkworms and better silk thread harvest.

The continuous production of mulberry for a long time results in a gradual reduction of leaf yield and quality. The highly intensive mulberry cropping system causes depletion of nutrients in the soil and excess usage of inorganic fertilizers, as well as pesticides, results in a deleterious effect on soil health.

Therefore the practices such as the application of fertilizers, weeding, irrigation, plant protection are important for good and healthy leaf production.

Fertilizing can be done by applying manure from local animal husbandry, compost, vermicompost, and green manures.

Green manure crops such as cowpea, horse gram should be incorporated into the soil by plowing before the rains cease. Subsequently, plots must be mulched with any dry material, it is a highly beneficial practice for enhanced moisture and nutrient conservation in soil.

Moreover intercropping with short duration pulse crop enriches the soil, gives additional revenue and also controls the weed growth. Mulberry is well suited for intercropping with a number of vegetables such as mung bean and cowpea and black gram.

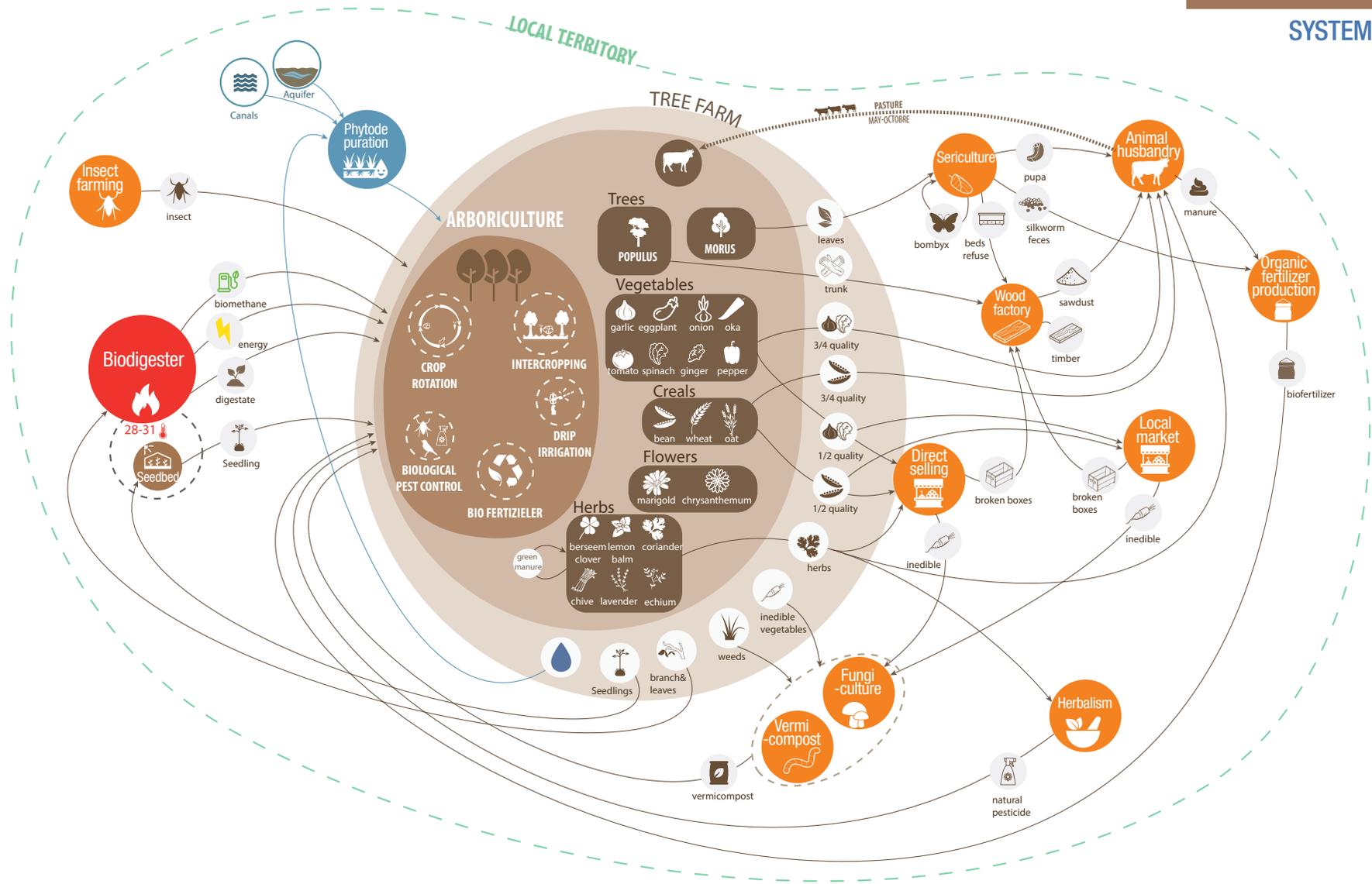
As mentioned in the previous section, biological pest control is an eco-friendly method for controlling pests, in mulberry trees Ladybird beetle is one of the beneficial insects for pest control.

Mulberry tree produces very large amounts of renewable biomass in the form of branches, shoots, leaves. Surplus foliage and leftover branches and leaves from silkworm rearing can be used for feeding livestock, or they can be used in vermicompost to make vermicompost. Moreover, they can be applied as an input to biodigester .



TREE FARMING

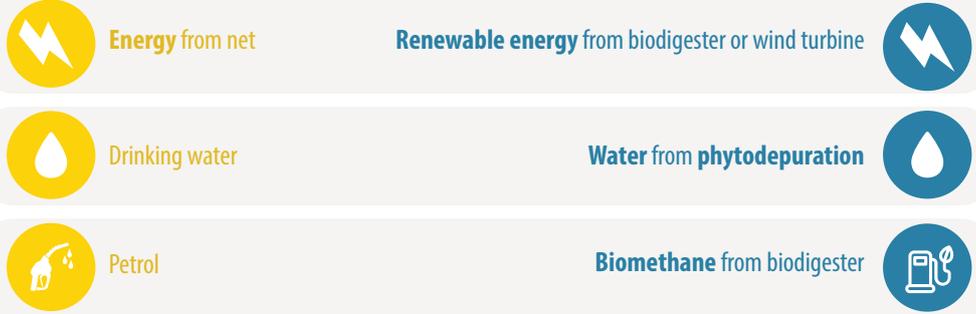
SYSTEMIC



CURRENT

SYSTEMIC

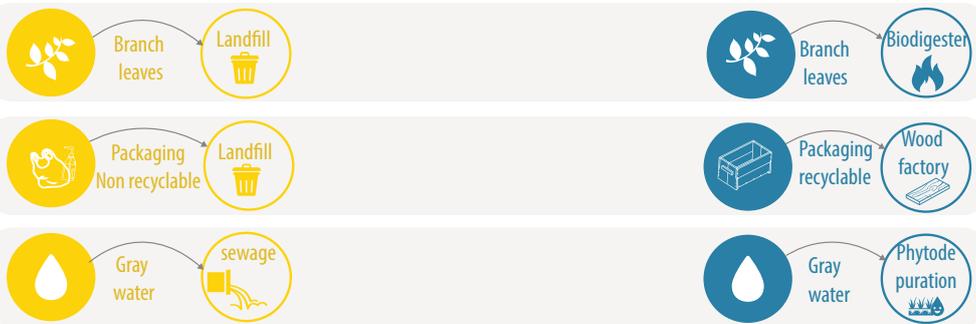
Resource



Inputs



Outputs



NEW OUTPUTS



process phases

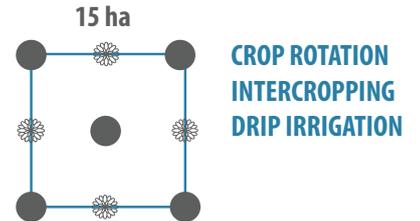
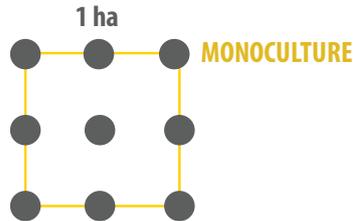
Outputs



Inputs



Agriculture methods



Results





**ANIMAL
HUSBANDRY**

CURRENT ANIMAL HUSBANDRY

In addition to agricultural activities, animal husbandry is also common as one of the widespread activities in this area.

There are a few farmers in this zone that have a significant number of cattle, they raise the cattle with various migration patterns; In summer they send them to enclosed wet pastures (Qoroq) on the bank of the Anzali lagoon and smaller marshy areas while in winter take them to forest pastures. However, the majority of animals reared in an intensive practice.

In Intensive breeding the main object is to obtain the maximum return from the animals with the minimum space and economic cost; The animals are concentrated in industrial sheds where, in the case of certain species, they are born, grown in the minimum space necessary to be able to develop the most essential biological and behavior standards. This industrial and machinist focus implies such harmful and negative practices for the animals such as the absence of ventilation and natural light, freedom of movement and exercise, prevention of mating, motherhood and natural breeding.



Poultry and cattle farming are the two main animal husbandry in this district; However, a small percentage of sheep, goat, and buffalo are also farmed.



In the following, the most important activities within the intensive livestock sector are explained:

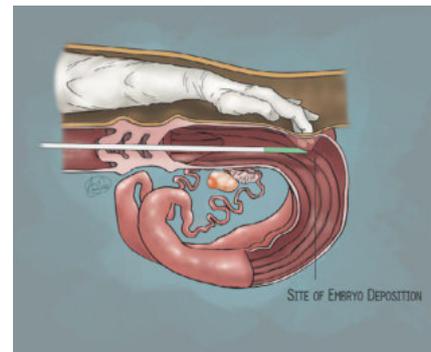
ARTIFICIAL INSEMINATION

Farmers generally rely on artificial insemination for the reproduction of their cattle. Artificial insemination is the process of collecting sperm cells from a male animal and manually depositing them into the reproductive tract of a female.

There are many reasons why artificial cow insemination is preferred by farmers. First and foremost is that it makes it much easier, and less costly, to inseminate a large number of cows. Also, with this method, the farmer does not have to bring an actual bull to the farm, which saves both time and money.

However, there are risks associated with artificial insemination, which has the potential to disseminate genetic defects and also to spread infectious disease nationally and internationally.

Nearly 85% of the semen that is used in artificial insemination in Iran, are GM sperm that is imported from the USA and Canada.



LIVESTOCK FEED

Animals are mainly fed by fodder that is provided outside the territory. They have a low quality of nutrients and often contain a wide range of contaminants and toxins from chemical residues that applied during cultivation. The effects of feed contaminants and toxins range from reduced intake to reproductive dysfunction and increased incidence of bacterial diseases.

In addition, some concentrate feeds and additives are added to their feed to speed their growth to market weight. Feed additives used to promote growth or to prevent diseases can alter the animals' self-regulating capacities thus affecting their welfare.



MEDICAL



A big portion of medicine is imported by large companies. In many cases, its employment is not suitable due to the lack of knowledge in the practices. However, the use of medicinal tools affects the animal productivity and the quality of their products.

One of the most used medicine is antibiotic, The livestock industry is the second largest consumer of antibiotics. Antibiotics are administered to animals in feed in order to prevent, control, treat disease and promote the development of livestock. There is growing evidence that antibiotic resistance in humans is promoted by the widespread use of antibiotics in animals that enter to the human food chain.

WATER

The daily water requirement of livestock varies significantly among animal species, animal's size and growth stage. The quality of the water, which includes temperature, salinity and impurities have effects can effect on cattle performance.

Unfortunately, in many areas in this province, drinking water doesn't have enough quality and in many cases, it is contaminated with sewage, this can decrease cattle performance and be a potential source of disease.

DISINFECTANTS

Cleaning and disinfecting are imperative to maintain the well being and health of high producing animals. This is especially the case in intensive modern housing where high density and high productivity increases the infection pressure. Thorough cleaning and adapted disinfection decreases the pathogen level and prevents or breaks the disease cycle. However chemical disinfectants have many negative effects on the environment and animal health.



HOUSING

CATTLE

Cows kept in tie-stalls, or stanchions, are individually tethered by the neck. Those reared in freestalls, or cubicles, are not restrained and are permitted to move within the barn. The yards typically provide bedding materials such as straw, but there are no individual lying places. Cows are not tethered or constrained and are free to walk within the yard. Animals suffer needless mutilations and cramped, confined living conditions that may lead to infections and diseases. Scientists have even linked animal stress to problems with food quality and safety. When an animal is subject to stress and pain, it is more prone to disease and can produce lower quality meat, milk.

HEN

Chickens and hens in intensive poultry farming often suffer from different conditions and pain. A lot of intensively reared chickens suffer from lameness as a result of fast growth, a result of selective breeding and concentrated feed. In addition, the way the cages are designed and as the chickens grow, their droppings accumulate on the floor. When the droppings decompose, ammonia is released. The ammonia then fills the air with unhealthy fumes and this puts chickens at risk of incurring painful blisters, hock burns or ulcerated feet.



OUTPUT

URINE AND MANURE

Urine and manure generated by the animal are highly contaminated. Excessive nutrients, microbial pathogens, and pharmaceuticals present in the waste have many negative effects on the environment and human health.

Pathogens in animal waste can contaminate food or water, or enter the body directly through inhalation, skin lesions, and other routes vulnerable to pathogen entry and cause zoonotic diseases.

METHANE

An important source of methane emissions is from enteric fermentation in farm animals. During their normal digestion process, the cattle create large amounts of methane. Methane is a greenhouse gas like carbon dioxide (CO₂). But the negative effect on the climate of Methane is 23 times higher than the effect of CO₂.

MEAT&MILK&EGG

The majority of the Medicines and antibiotics, hormone products, remain deposited in the animal's organism, and their toxic and harmful residues pass on, through their products to the organism of those that consume it. allergies, resistance to antibiotics, medical diabetes, osteoporosis, congenital malformation and growth problems, are some of the consequences that can be derived from byproducts.

ANIMAL WASTE

Animal waste and discards are often not treated appropriately with farmers often disposing their waste in rivers or throwing out into the sewer where they pollute the water and threaten the ecosystem's biodiversity.

WATER WASTE

In the same way, gray water generated during cleaning or washing and other activities are thrown away into the sewer or discarded in the soils near where the activity is carried out.

HANDLING AND TRANSPORT

Rough handling is a major cause of stress, bruising, and injuries. Cattle may find transport to be threatening and unfamiliar, involving a series of stressful handling and confinement experiences. The animals face stressors from noise, motion, and potentially extreme temperatures and humidity that may cause injury and even death.

Transport can also reduce welfare by affecting immune function and increasing the likelihood of disease. By the end of their journey to slaughter, cattle may be weakened, hurt, or diseased.



SLAUGHTERHOUSE

In Iran slaughter are based on Islamic law. The animal has to be alive and healthy, a Muslim has to perform the slaughter in the appropriate ritual manner, and the animal's throat must be cut by a sharp knife severing the carotid artery, jugular vein and windpipe in a single swipe. Blood must be drained out of the carcass.

If the animal is stressed before and during slaughter, the glycogen is used up, and the lactic acid level that develops in the meat after slaughter is reduced. This will have serious adverse effects on meat quality.



CURRENT



Resource



Energy from net

Non renewable energy



Drinking water

Water depletion



Petrol

Non renewable energy

Inputs



GM sperm

Threaten native breeds
Disseminate genetic defects
Infectious disease internationally



Chemical Medicine

Atibiotic resistance
Effect on productivity



Concentrated Feed

Alter self-regulating



Contaminated feed
from intensive farm

Incidence bacterial diseases
Reproductive dysfunction
Poor nutrients



Disinfectants

Environmental pollution
Threaten human health

Outputs



Contaminated
manure

Soil contamination if
used in agriculture



Packaging
materials

Non recyclable
Environmental pollution



Organic
waste

Not valued
Contaminated with chemicals

Agriculture methods

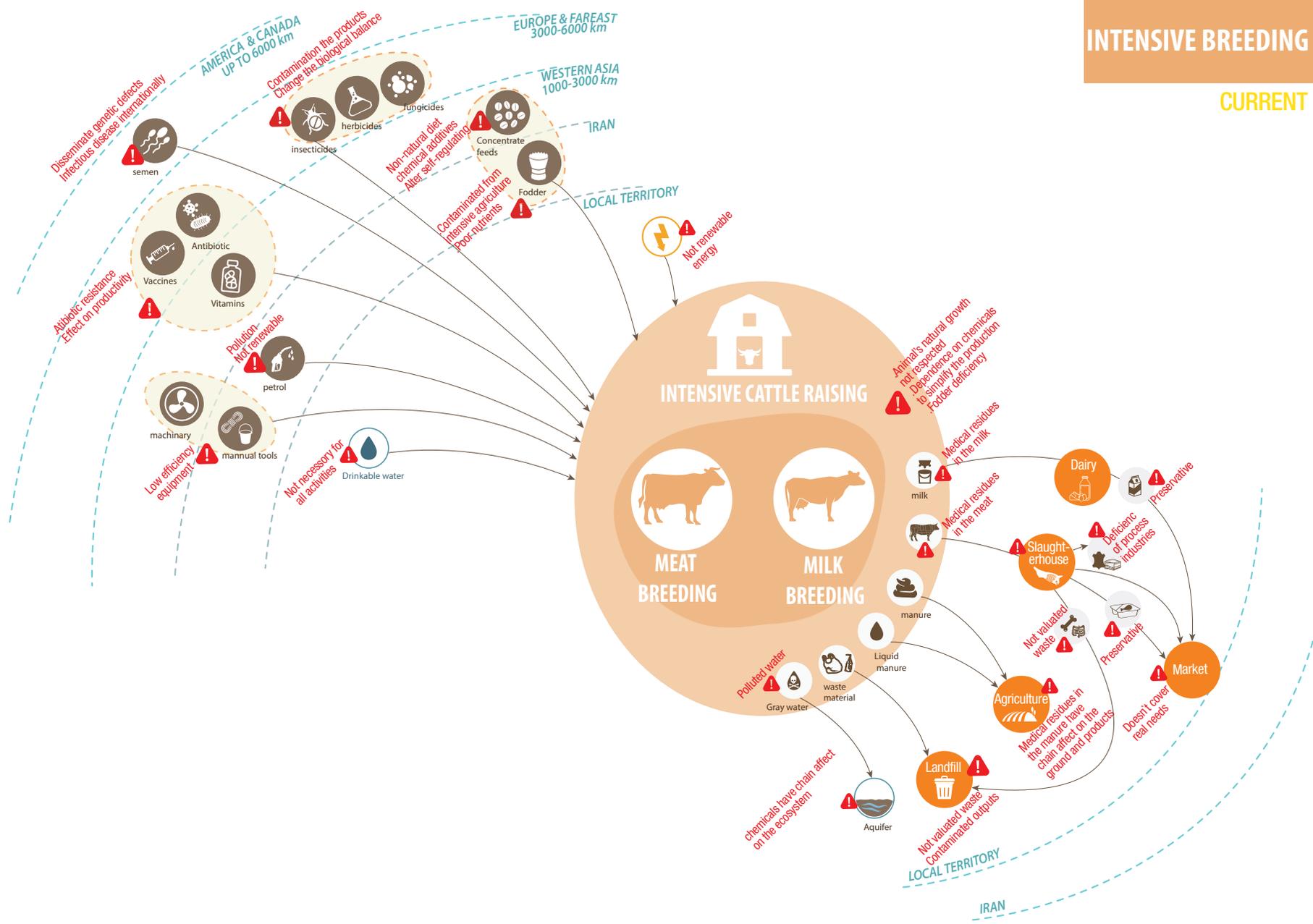


Intensive farm

Changing Organism Resistance
High use of growth hormones
High use of chemical medicine
Inhuman slaughtering
Contaminated products
Non-welfare
Stress to animals

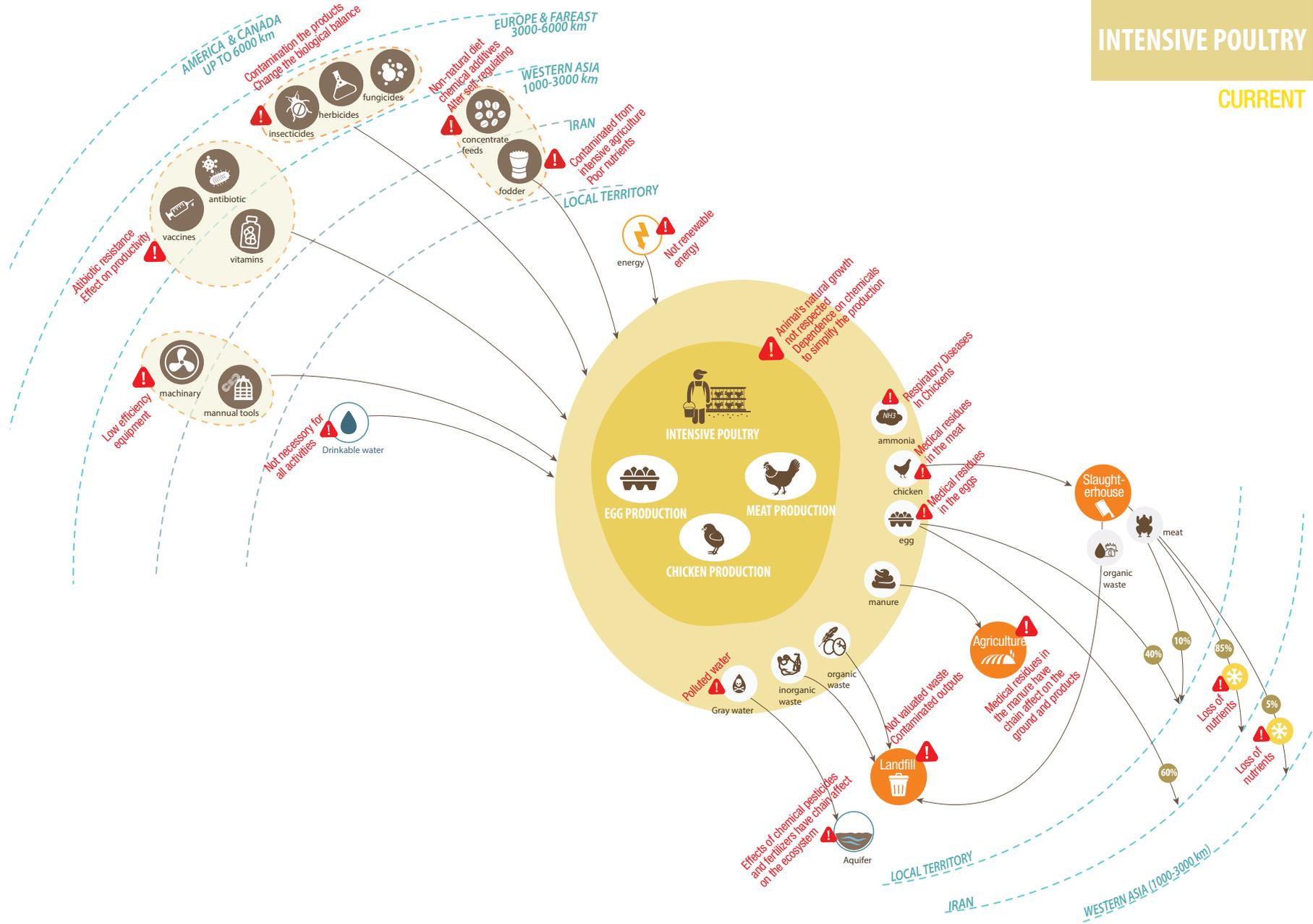
INTENSIVE BREEDING

CURRENT



INTENSIVE POULTRY

CURRENT



SYSTEMIC ANIMAL HUSBANDRY

The quality of animal products and other outputs from livestock depend on the animal nutrition and the well-being. By providing proper nutrition and living condition we are able to guarantee the outputs of the system, in which, they can be confidently consumed or used in other activities.

Below are going to be explained the components that were essential for achieving these goals:

To start, one of the best practice is the use of a pasture-based system; in this systems, animals roam freely in their natural environment where they're able to eat nutritious grasses and other plants that their bodies are adapted to digest. In addition to dramatically improving the welfare of farm animals, pasturing also helps reduce environmental damage, and yields meat, eggs, and dairy products that are tastier and more nutritious than foods produced on factory farms.

Animals raised on pasture enjoy a much higher quality of life than those confined within factory farms.



Eating grasses and plants allow animals to produce saliva, which helps neutralize acids that exist naturally in their digestive systems, causing a decrease in acidity within its digestive tract; So the number of health problems decrease significantly. Also in pasture-raised animals, there is no need for the unnatural feed additives. On pasture, animals get all the nutrients they need from grass and forage, and some animals, like chickens, get additional vitamins and protein from eating insects.

LAND POTENTIAL FOR GRAZING

WETLAND PASTURE

As can be seen below, during spring and summer low tide provides outstanding opportunities for grazing along the margin of Anzali wetland these fertile lands provide cover and forage for livestock.

High tide in southern parts of Anzali wetland (Novembre- April)



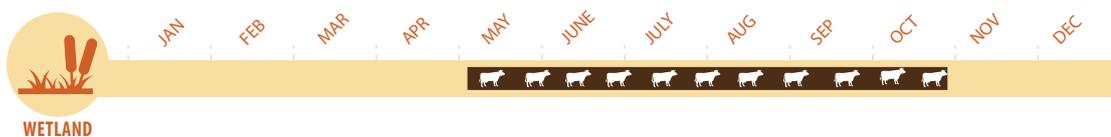
Pastureland area

Siah Darvishan zone : 2200 ha
Hendekhale : 500 ha
Torabkhale : 600 ha
Baghlakesh : 800 ha
Mahmodabad : 800 ha

TOTAL : 4900 ha

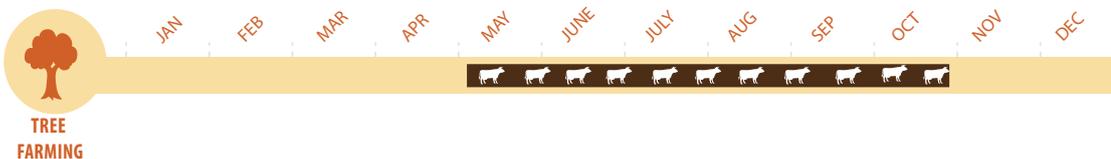
Low tide in southern parts of Anzali wetland (May-October)





SILVOPASTURE

As mentioned in tree farm section, In this area 10,000 ha of land is devoted to Populus farming; As explained, when the poplars are more than 4 years old, the farm has a good potential for grazing the livestock. Populus create shelter for animals, while intercropped Lucerne provides a useful source of protein for feeding the cattle.



INTEGRATED ANIMAL FARM

This polyculture system includes cattle, sheep and chickens while some crops are cultivated in the farm that benefits from natural fertilizer is provided by animals, composted manure, and biomass residues. The relationship between the cattle and chickens is dynamic, cattle graze cells intensively, and chickens then graze that cell in a mobile chicken barn, feeding off insect larvae around cattle manure.

This provides a protein-rich diet for egg production while also fertilizing the pasture with chicken manure. Chickens can picking through dung and cow patties for larvae, maggots, and parasites. Most parasites are species-specific and chickens safely interrupt the parasite life-cycle by eating them. Chickens also keep fly populations down by eating maggots, and they help spread manure and mix it back into the soil. Chickens also eat undigested feed and seeds that are passed through manure, thus reducing feed waste. This process also fertilizes the grass. The grass grows thicker and healthier, which provide better for feeds the cows and chickens.



FEEDING

During cold seasons that there isn't access to pasture, animal should be fed by natural feed produced from local agriculture or organic waste by activities.

Some of outputs and waste from other activities that are rich in nutrients and can be used for animals are listed below:

BAGASSE



Sugarcane bagasse is the major by-product of the sugar cane industry. It contains about 50% cellulose, 25% hemicellulose and 25% lignin. It can serve as an ideal substrate for animal feed.

MOLASSE

Sugarcane molasses is a viscous, dark and sugar-rich by-product from refining sugarcane. Sugarcane molasses has several important roles in livestock feeding, due to the nutritive, appetizing and physical properties of its sugar content.

SILKWORM PUPA



Silkworm pupae are a waste material from Sericulture. Due to its high protein content, silkworm pupae meal has been found suitable as a livestock feed, notably for monogastric species.

AZOLLA



Azolla is rich in protein, almost 25-30 % , it is also found to contain essential minerals like Iron, Calcium, Magnesium, Phosphorus, Copper, Manganese etc. Livestock can easily digest Azolla due to high protein content and low lignin content.

FOLIAGE

The foliage such as branches, shoots, leaves generated from poplars or other activities are rich in nitrogen and protein and can be used for animal feed.

TRADITIONAL METHOD FOR FEEDING

According to some Indian beliefs, 3 energy zones influence milk productivity.

First one is emotional energy; Cows with positive energy can produce good quality and more quantity milk. Plants such as winter cherry, holy basil, ginger and mint provide great energy further they have multiple benefits, distress herb, immunity booster and insect repellent.

The second one is digestive energy, Cows with healthy digestion can convert feed into good quality milk. So it is important to maintain and support good digestive health, some of the powerful digestive herbs are aloe vera and ginger; by growing them around the farm, we can add great benefits to our cattle.

The last one is udder immunity energy; Cows with good udder immunity can stay healthy and produce high quality and quantity of milk, the famous herbs which are Turmeric garlic.

DIGESTION ENERGY



Aloe vera



Ginger

EMOTION ENERGY



winter cherry



Holy Basil



Ginger



Mint

UDDER IMMUNITY ENERGY



Turmeric



Garlic

ANIMAL HEALTH CARE

ETHNOVETERINARY MEDICINE

Ethnoveterinary medicine is defined as the medicine that is used by the local farmers to treat the diseases of both human and animal patients using all resources other than modern synthetic drugs. There are many traditions of veterinary medicine such as acupuncture and herbal medicine, Tibetan veterinary medicine, Ayurveda and etc that can be validated and use. Some of them is explained below:

Veterinary acupuncture is performing acupuncture on animals. Acupuncture is used mainly for functional problems such as those involving noninfectious inflammation, paralysis, or pain. For small animals, it used for treating diarrhea, and certain reproductive problems. While larger animals, used for



treating downer cow syndrome, respiratory problems, nonsurgical colic, and certain reproductive disorders.

Homoeopathy is also becoming popular as an alternative to conventional medicines in animals too. It is one of the best holistic and safest treatments for animals. The idea behind using Homeopathy is to strengthen the immunity of the animals and treat the disease from the roots.

CATTLE BREEDS

In this region, there are many native breeds, but they are going to be disappeared because most semen for farming are imported from foreign countries. Farmers are reluctant to rearing native breeds; it is believed by them that the native breeds don't produce enough milk as imported breeds, Even though these breeds produce less milk but the quality and the taste aren't comparable with imported ones.

Unfortunately, there isn't enough information about cattle breed in Iran. here is some few information about them:

MAZANDARANI



The hump indicates zebu affinity and this is supported by genetic evidence. They are usually solid black or brown with some white arcs or spots. They are kept for meat and milk production, Both male and female cattle have horns. They are Resistance to parasitic disease.

Milk production 450 kg/year - fat 5%

Lactation period 8-12 months

TALESHI



Taleshi cattle have a big body with a hump. They are kept for meat and milk production.

Milk production 645 kg /year -fat 5%

Lactation period 220-230 days

WATER BUFFALO



They are large dark color with thick neck and a heavy spreading horns.

Mass: 300 – 600 kg (Adult)

Gestation period: 300 – 320 days

Milk production 1400-1600 kg / year - fat 6-8%

NAKED NECK

The Naked Neck is a breed of chicken that is naturally devoid of feathers on its neck and vent. The breed is a dual-purpose utility chicken. They lay a respectable number of light brown eggs, and are considered desirable for meat production because they need less plucking and they have a meaty body. They are very good foragers and are immune to most diseases.

Weight : 1.6-2.4 kg

100- 110 eggs/ year



ZARD KORK

The zard kork is a breed of chicken with yellow feathers. They are more resistant to heat than normal chickens.

Weight : 1100-1500 kg

130 eggs/ year



OUTPUTS

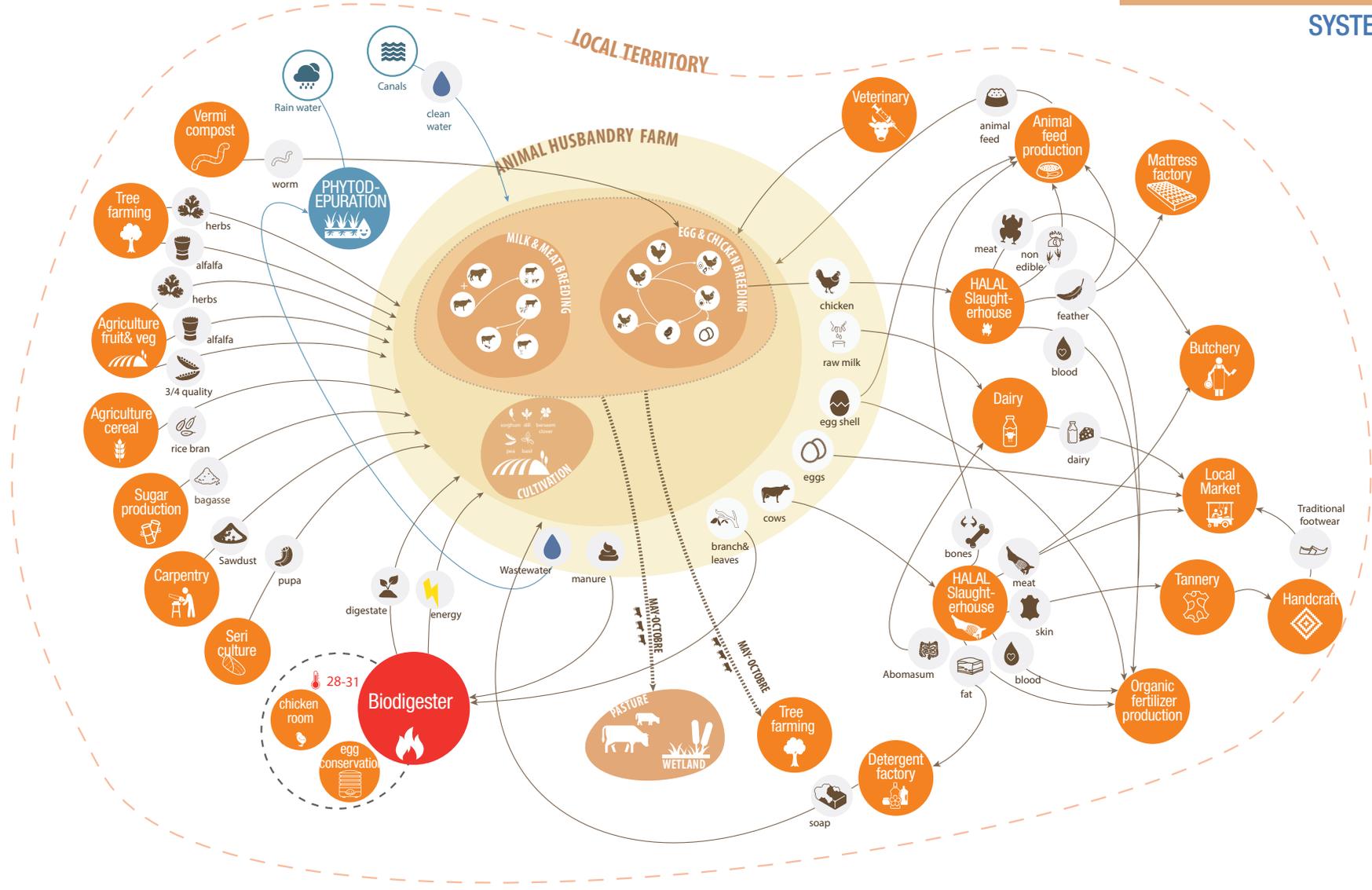
Pasture-raised meat, eggs, and dairy products are better for consumers' health. In addition to being lower in calories and total fat, pasture-raised foods have higher levels of vitamins and a healthier balance of omega-3 and omega-6 fats than conventional meat and dairy products. Moreover, they are more flavorful.

Also, Urine and manure generated by the animal are of an enriched quality and can be used as organic fertilizer in agriculture.

Further organic waste such as eggshell, are nutritious and can be used in fertilizer or animal feed production.

ANIMAL HUSBANDRY

SYSTEMIC



CURRENT

SYSTEMIC

Resource



Energy from net

Renewable energy from biodigester or wind turbine



Drinking water

Water from phytodepuration



Petrol

Biomethane from biodigester



Inputs



GM sperm

Native breeds



Chemical Medicine

Ethnoveterinary medicine



Concentrated Feed



Contaminated feed from intensive farm

Feed from local farm



Disinfectants

Organoc detergent



Outputs



Contaminated manure



Manure



Packaging Non recyclable



Packaging recyclable



Organic waste



Organic waste



Agriculture methods



Intensive farm



Pasture-based farm Integrated farm

CURRENT

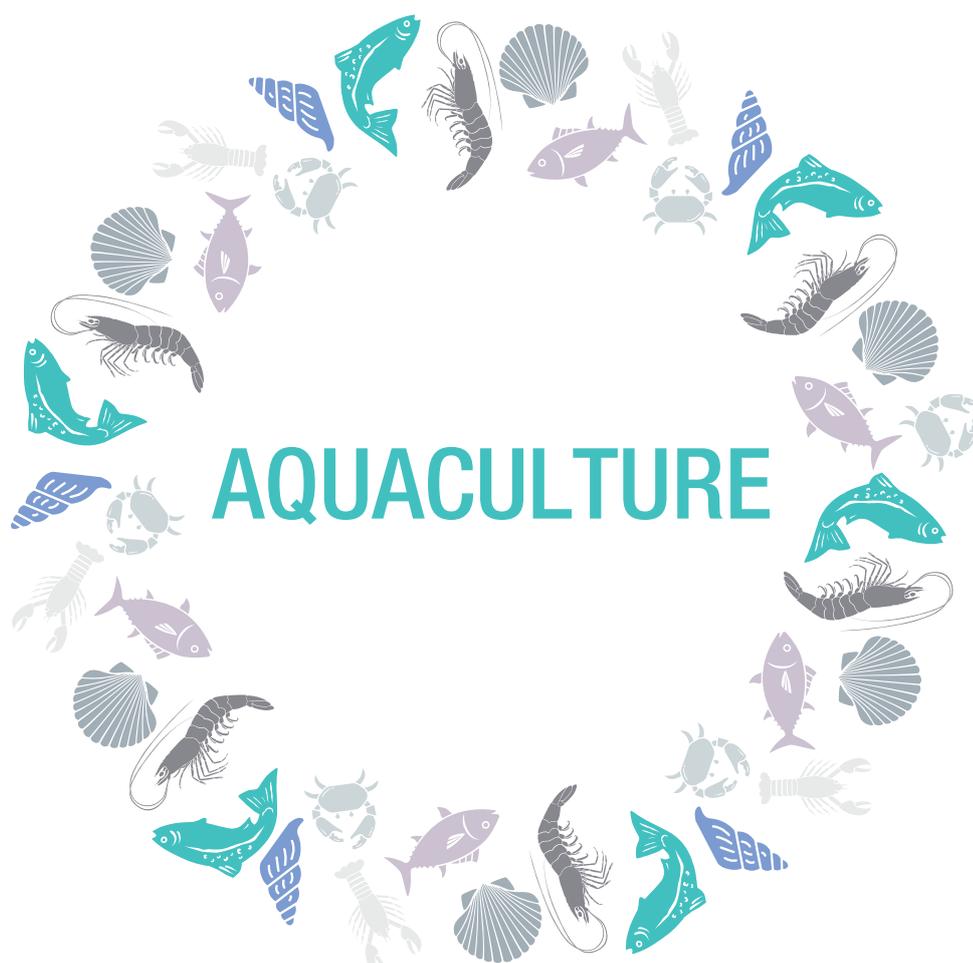


SYSTEMIC

Results

-  Competitive
-  Unfair prices
-  Environmental degradation
-  Uninformed Consumers
-  Human health risk

- Cooperation 
- Fair prices 
- Preventing environmental degradation 
- Creating relationship between producers and consumers 
- Improving human health 



AQUACULTURE

Aquaculture is the breeding, rearing, and harvesting of fish, crustaceans, mollusks, aquatic plants, algae, and other organisms in all types of water environments. It can take place in natural bodies of water such as ponds, lakes, and marshland as well as brackish water and the ocean.

Fish farming is an ancient industry that has become increasingly sophisticated in recent years. A huge global demand for seafood has made fish farming, or aquaculture, the world's fastest-growing food industry.



HISTORY OF AQUACULTURE

Around 500 BC, the Romans farmed oysters and fish in Mediterranean lagoons, whereas freshwater aquaculture developed empirically some 1000 years earlier in China. Farming carp in ponds led to the complete domestication of this species in the Middle Ages, which is also when mussel farming began, following a technique that remained largely unchanged until the 20th century.

The earliest evidence of fish farming dates back to before 1000 BC in China. During the Tang dynasty, around 618, the Emperor Li, whose name means 'carp', forbade farming the fish that bore his name. Farmers then turned their

attention to similar fish in the Cyprinidae family and developed the first form of polyculture.

In Europe, aquaculture first began in Ancient Rome. Mussel farming was invented in the 13th century and the technique remained largely unchanged until the 1960s. In a hundred years, industry changed the European landscape. Pollution caused fish populations to diminish. To combat this dramatic decline, artificial breeding research focused on trout farming, and researchers managed to master all stages of the process, from fertilization to egg storage and transportation, pond farming and releasing fish into the wild.

In the late 1950s, the invention of artificial granulated food revolutionized fish farming, which until then had relied on products from agriculture and livestock farming (raw meat, for example), to feed the fish.



AQUACULTURE METHODS

There are three main types of aquaculture:

MARICULTURE

Mariculture refers to aquaculture practiced in marine environments and in underwater habitats. Marine aquaculture produces numerous species including finfish and shellfish like prawns, or oysters and seaweed in saltwater ponds. Non-food products produced by mariculture include fish meal, nutrient agar, jewelry (e.g. cultured pearls), and cosmetics.

FRESHWATER

Freshwater aquaculture is carried out either in fish ponds, fish pens, fish cages or, on a limited scale, in rice paddies. Freshwater aquaculture produces species such as catfish and trout. Freshwater aquaculture primarily takes place in ponds or other man made systems.

BRACKISHWATER

Brackish water aquaculture is done mainly in fish ponds located in coastal areas.

FISH FARMS TYPES

There are different types of fish farms:

CAGE SYSTEM

Fish cages are placed in lakes, rivers, ponds or oceans to contain and protect fish until they can be harvested. It is also called “off-shore cultivation” when the cages are placed in the sea.



POND SYSTEMS



This system uses irrigation ditches or farm ponds to raise fish. The basic requirement is to have a ditch or pond that retains water, possibly with an above-ground irrigation system.

TANK – INDOOR SYSTEMS



An alternative to outdoor open ocean cage aquaculture is through the use of a recirculation aquaculture system, which is a series of culture tanks and filters where water is continuously recycled and monitored to keep optimal conditions.

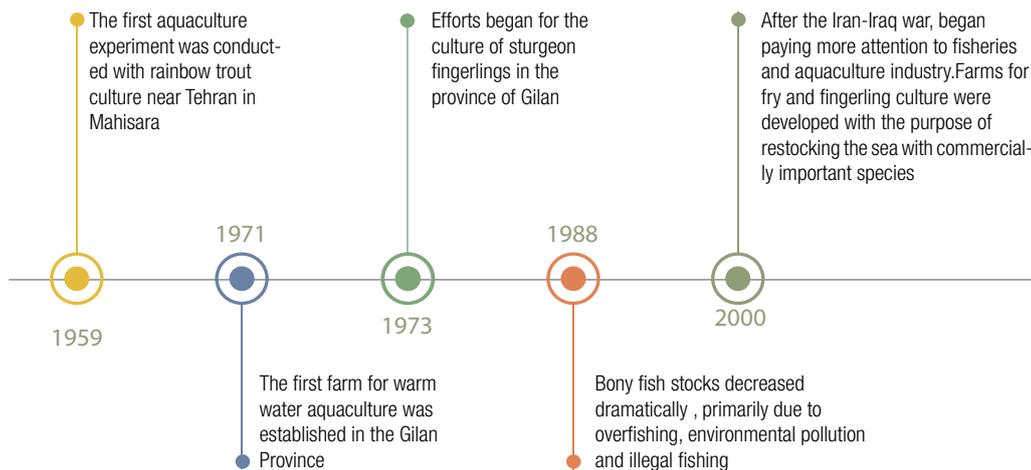
RACEWAYS SYSTEMS



Also known as a flow-through system, is an artificial channel consists of rectangular basins or canals constructed of concrete and equipped with an inlet and outlet. A continuous water flow-through is maintained to provide the required level of water quality, which allows animals to be cultured at higher densities within the raceway.

AQUACULTURE IN IRAN

Iran has over 50 years of experience in aquaculture. Most aquaculture production in Iran is comprised of freshwater species except for marine shrimp production (about 6% of the total). However, there is also a very small cage culture industry in the south of Iran.



The total production of Iran from aquaculture is approximately 27% of the total fisheries production.

The carp culture industry is currently the most important sub-sector of fisheries in Iran and its rapid development has attracted considerable attention in recent years.

FISH FARMING IN SELECTED ZONE

With abundant water resources such as natural, seminatural and artificial water-bodies and earth dams, barrage dams and irrigation reservoirs that are distributed through all the provinces, this area has a great potential in the aquaculture industry.

In this area, there are some 950 registered carp culture farms, with a total pond area of almost 1,700 ha, which annually produces up to 12,000-ton fish.

About 70 percent of fish growers in this district are rural households who, along with farming and livestock breeding, either create part of their own ponds on fish farming.



CURRENT AQUACULTURE

As Carp is the main fishes that cultivated in this area in this chapter the main Principles of carp breeding is discussed.

COMMON CARP



Carp are various species of oily freshwater fish from the family Cyprinidae. It generally inhabits freshwater environments, especially ponds, lakes and rivers, and also rarely inhabits brackish-water environments. They are omnivorous that can eat a herbivorous diet of aquatic plants but prefer to scavenge the bottom for insects, crustaceans, crawfish, and benthic worms.

Common carp is frequently called an 'ecological engineer' because it can modify ecological characteristics of aquatic systems.

REARING METHOD

MONOCULTURE



Most of the pond spread throughout the country are being farmed in monoculture methods. Monoculture fish farming refers to the fish farming where only one type of fish species and breed is raised on a farm. Regression in water quality, cannibalism among fish themselves, overstocking of the pond with fish which may lead to diseases outbreak are the main disadvantages of monoculture fish farming.

REPRODUCTION

Common carp spawns from late spring until early summer in repeated occasions. Artificial propagation is the common method for reproduction, it includes:

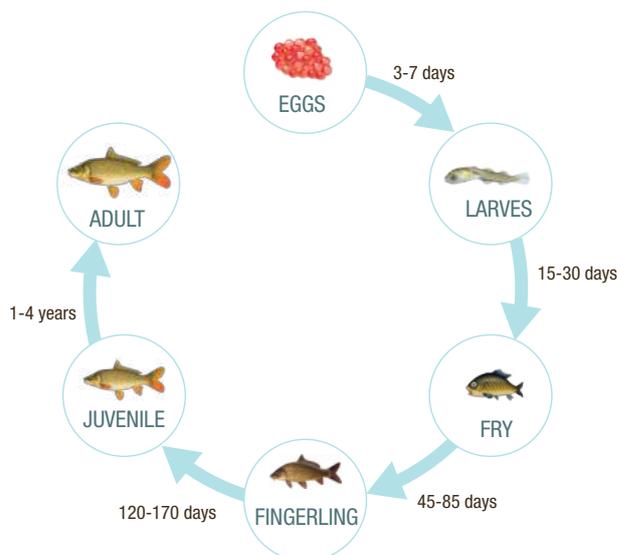
Ovulation in females with hormone injections, stripping, fertilization and incubation of eggs, as well as the rearing of hatched non-feeding and feeding larvae.

After hatching, larvae are transferred to tanks and fed with powdered yolk and milk. After about 8 days they are transferred to nursery ponds where they feed. Fries of 10 g size are usually transported for release into water-bodies, or grown to market size on fish farms.



FISH LIFE CYCLE

The distinctive developmental stages of common carp are described below, however, it depends on many factors such as environmental and cultural conditions.



NUTRITIONAL REQUIREMENTS

In the intensive fish farm, because very high stocking densities are maintained, the cultured fish has to rely on the artificial feeds. These diets supply all the ingredients (protein, carbohydrates, fats, vitamins, and minerals) necessary for the optimal growth. They are mostly imported from France, Thailand, and Vietnam. While they are expensive but don't have enough quality.



There are different additives that are added to feed ingredients. While some substances supply essential nutrients, there are some other additives included in diets for reasons other than to provide nutrients. Some of these nonnutritive feed are explained below :

BINDERS improve the efficiency of the feed manufacturing process, to reduce feed wastage and to produce a water-stable diet.

FOOD COLORANTS are substances which are added to facilitate its ingestion (through improved visibility of feed particles) or to impart a desired coloration within the carcass of the cultured fish.

FEEDING STIMULANTS are substances which are added to facilitate its ingestion.

HORMONES are added to facilitate growth.

ANTIBIOTICS are widely added to fish feed to prevent infections, treat animals and facilitate growth.

Application of artificial feed affects water quality criteria more than any other management factors. As a result, freshwater bodies produce excessive plankton blooms which use dissolved oxygen.

Decomposition of uneaten food also results in oxygen demand. Therefore, the amount of fish that can be produced in lentic water bodies is dependent upon the amount artificial feed to be added while maintaining proper water quality enough for fish growth.

CHEMICAL FERTILIZERS

Chemical fertilizers are normally used in fish pond to stimulate phytoplankton production which increases fish yields. They contain inert filler material mixed with three important minerals, nitrogen, phosphorous and potassium which are needed by phytoplankton in fish ponds. A commonly available chemical fertilizer contains 12%nitrogen, 24% phosphorous and 12% potassium.



WEED CONTROL

Aquatic plants grow in ponds are beneficial for fish because they provide food, dissolved oxygen, and spawning and nesting habitat for fish. However, if they become excessive, it may result in adverse effects on fishpond management and can threaten them. They reduce sunlight penetration into the water and reduce photosynthesis, they absorb too many nutrients from water and bottom mud. To control these plants different types of chemical such as pesticides, herbicides or algacides are applied .



AQUATIC INSECTS CONTROL

Aquatic insects prey directly on carp spawn or injured the young ones by sucking body fluid or indirectly competing for food with carp spawn. these insects are controlled by insecticide.

HARVEST

In Gilan, harvest starts in September. The standard market size for carp is about 1 kg. Some farmers may delay their harvesting up to November, or even December to obtain larger fish and potentially better prices.

Harvesting is done by draining water from the pond or by using a net and usually carried out by the farmers. The majority of farmers harvest a pond only once a year, or even once per farm, but very large ponds or farms may require more than one harvest.



TRANSPORT

On reaching slaughter weight, fishes are in some cases transported to the slaughter plant the loading and transporting can cause extensive stress in fish. Poor conditions during transport, such as overcrowding and inadequate water quality, may result in irreparable damage to the fish and mortality.



SLAUGHTER METHODS

Inhumane methods of fish slaughter are still widespread. The traditional method for killing farmed fish is to allow them to asphyxiate in the air or on the ice, which is slow and distressing.

Different methods for the slaughter of fish are in place and it is no doubt that many of them may be considered as appalling from an animal welfare point of view.

AIR ASPHYXIATION

This is the oldest slaughter method for fish and is considered inhumane because it can take the fish over an hour to die

ICE BATH (live chilling)



This method involves putting fish in baths of ice water, where they chill and eventually die of anoxia. Because chilling slows metabolic rate and oxygen needs, it may prolong the duration until death in some instances, with some cold adapted species taking more than an hour to die.

CO2 NARCOSIS

it involves filling the pond with CO2 to produce acidic pH, which injures the brain. it is a stressful procedure. CO2 immobilizes the fish within 2–4 minutes,

SALT OR AMMONIA BATHS

Salting involves the application of salt to the pond, to weaken the fish.

EXSANGUINATION

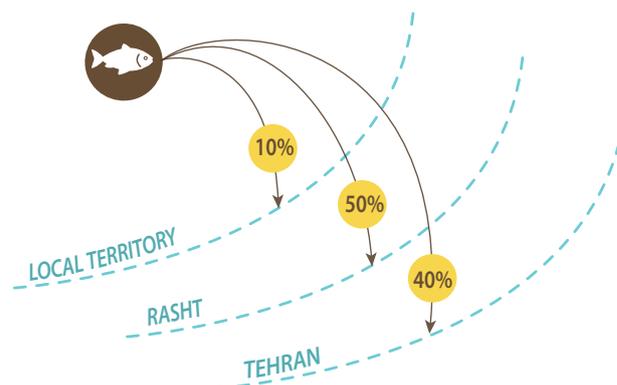
Exsanguination is the process whereby an animal is cut so that it bleeds to death.

FISH MARKET



Carp farmers use different marketing channels depending on the quantity of fish they have for sale. In general, small carp producers sell to local markets, dealers or wholesalers within the same province, whereas large producers would ship directly to the capital or other large provincial fish markets.

As can be seen below, 50% of carp production is sold to wholesalers in Rasht city, the center of Gilan province, 10% to the Anzali fish market and the balance is shipped to Tehran.



OUTPUT

FISH

A wide range of chemicals applied during rearing effects on fishes, they concentrate extremely high levels of chemical residues in their flesh and fat that may pose human health risks.

WATER

In some cases, dirty water in ponds or tanks must be changed. Depending on the system's set-up, this can result in the discharge of significant amounts of wastewater containing chemicals, feces, and nutrients released into the environment, that could change the composition of them. The release of this matter to the surrounding aquatic ecosystem can result in eutrophication.

UNVALUATED ORGANIC WASTE

Waste products, including feces, uneaten food, and dead fish, are flushed into the surrounding waters or ends up at the landfill. They are contaminated by the chemicals applied during farming and have negative on environments.

ESCAPED FARMED FISH

Escaped farmed fish from the pond can threatening native fish populations. They can compete for food and habitat, displace indigenous species and interfere with the life of wild species. They can also carry diseases and parasites that might kill native species. Additionally, escaped farm fish are able to breed with the wild stock which can dilute the natural gene pool and threaten the long-term survival and evolution of wild species.

.

CURRENT



Resource



Energy from net

Non renewable energy



Drinking water

Water depletion



Petrol

Non renewable energy

Inputs



Gm Eggfish

Loss of diversity



Chemical Medicine

Atibiotic resistance
Effect on productivity
Alter self-regulating



Concentrated fishmeal

Alter self-regulating
Effects water quality



Disinfectants

Environmental pollution
Threaten human health



Chemical fertilizer

Water contamination
Eutrophication

Contaminated manure

Outputs



Fish

Contaminated with chemical residue threaten human health



Packaging materials

Non recyclable
Environmental pollution



Organic waste

Not valuated
Contaminated with chemicals



Gray water

Eutrophication on other water bodies
Soil contamination

Agriculture methods

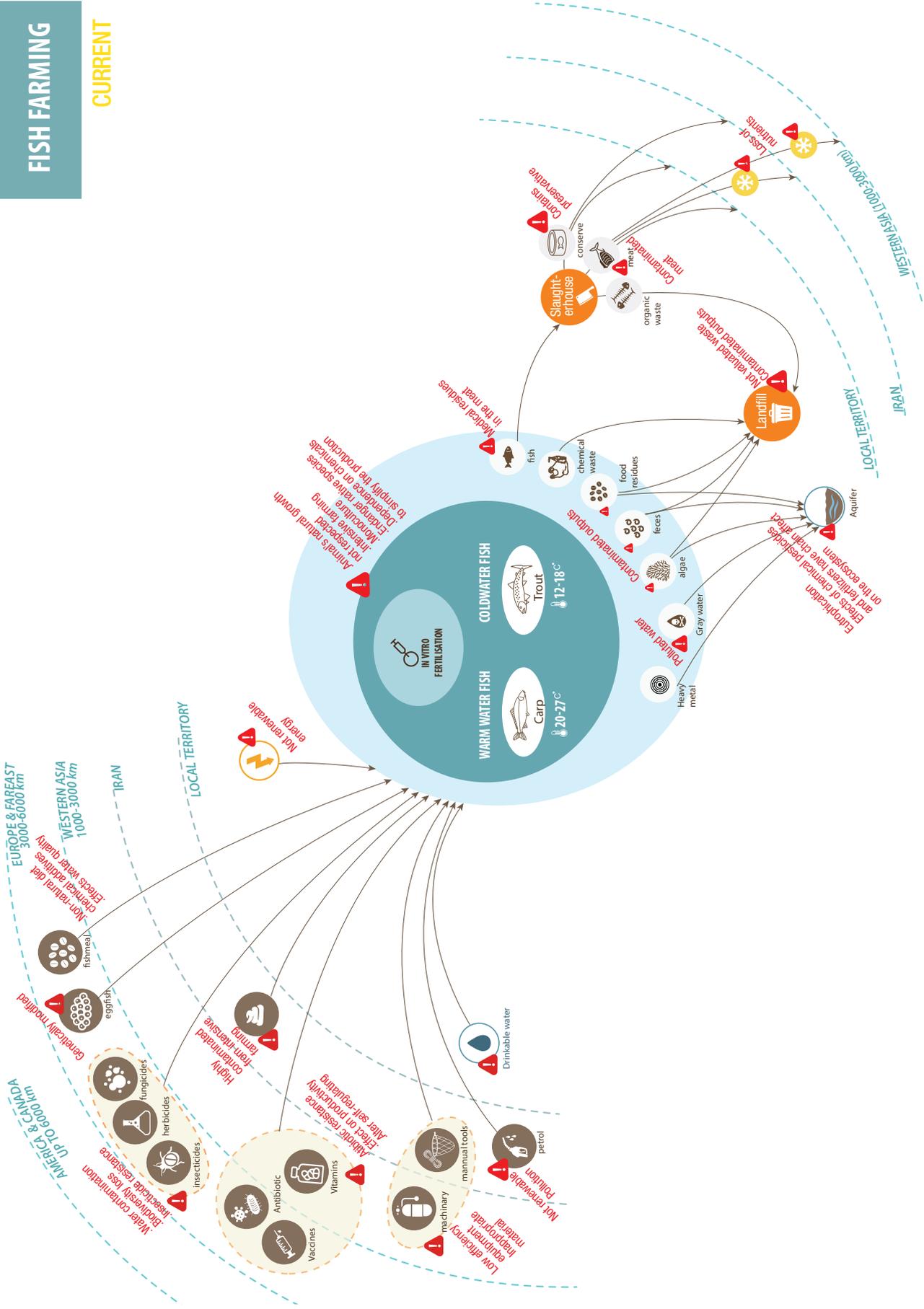


Monoculture farm

Cannibalism
Overstocking & Non-welfare
High use of growth hormones
Artificial propagation
Non-welfare
Stress to animals

FISH FARMING

CURRENT



SYSTEMIC AQUACULTURE

By producing fish in sustainable methods, we will be using the resources with responsibility and in the right way without negatively impacting the ecosystem or the environment. Sustainable fish farming also means that if you maintain the ecological balance, you will be able to produce a good supply of food and other benefits from your farm almost as long as you live.

POLYCULTURE

Many strategies have been suggested, evaluated, and proven in order to advance the sustainability of aquaculture, one of the most effective methods is polyculture.

Polyculture means cultivating various species of fish together by fully using of all water level food available in the pond.

Since common carp is the major cultivated fish in this region in this part a polyculture base on carp is explained.

SELECTING SPECIES

Selection of species in polyculture is very important. One of the main characteristics is rearing together fish species which have partly or entirely different food spectrum and feeding habits. This ensures that all kinds of natural fish food organisms which develop in different biotopes of a pond will be exploited properly.

Combinations of four carps include bighead, silver, grass carp and the common carp with the Ratio of 40% silver carp, 10% big head, 15% Grass carp and 35%common carp is one of the best performing practice for polyculture.

SILVER CARP

The silver carp is a filter feeder and possesses a specialized feeding apparatus capable of filtering small particles. The Silver Carp fish have no stomachs. They largely feed on phytoplankton, but also consume zooplankton and detritus. Mainly because of their plankton eating habit, they are sometimes used for controlling water quality.

GRASS CARP

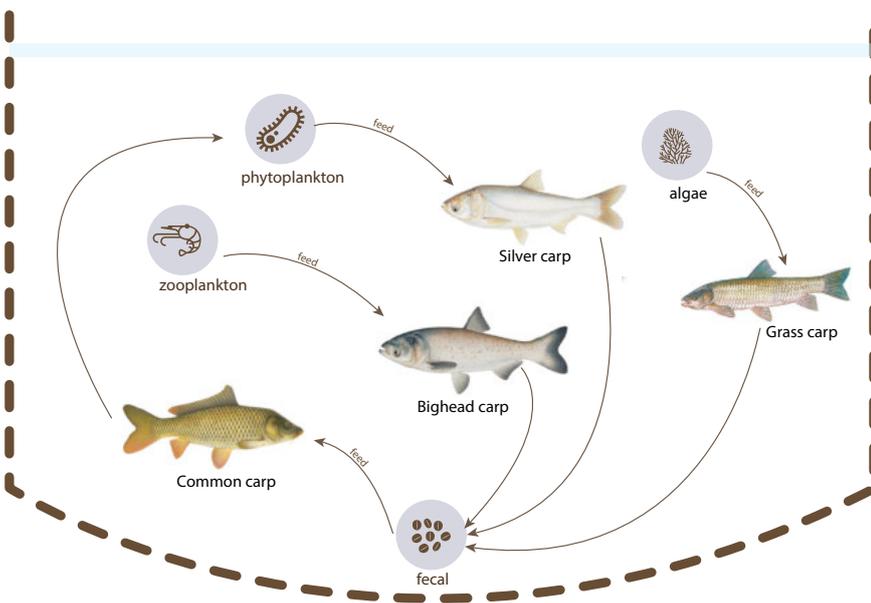
It is a large herbivorous freshwater fish species. They are fed mainly on aquatic plants. But they may also take detritus, insects and other invertebrates.

BIGHEAD CARP

Bighead carp generally have a mottled silver-gray body color. The Bighead Carp fish are powerful filter-feeders with a wide food spectrum that grows fast and reproduces quickly. This specialty makes them a strong competitor. They preferentially consume zooplankton, but also phytoplankton and detritus.



CARP POLYCULTURE



As can be seen above The silver carp feeds on phytoplankton in the water column, the bighead consumes zooplankton, the grass carp eats plants, and common carp eat benthos/detritus. Here are two main synergistic interactions among carp species reared in polyculture. First, silver carp fecal pellets rich in partially digested phytoplankton are eaten by common carp that otherwise could not utilize these algae. Second, common carp stir up mud, recirculating

nutrients into the water column that interfere with the development of filamentous algae and higher plants, thereby increasing nutrient availability for phytoplankton production and hence food for silver carp.

Algal blooming is common in most tropical manure fed ponds. By stocking phytoplanktophagous Silver carp in appropriate density certain algal blooming can be controlled. Grass carp on the other hand keeps the macrophyte abundance under control due to its macrovegetation feeding habit and it adds increased amount of partially digested excreta which becomes the feed for the bottom dweller coprofagous common carp. The bottom dwelling mrigal, common/mirror carp help re-suspension of bottom nutrients to water while stirring the bottom mud in search of food. Such an exercise of bottom dwellers also aerates the bottom sediment.

FERTILIZING

The production of natural food organisms in ponds can be supported by applying manure or fertilizers. These materials increase the production of bacteria, plants and animals (worms, insects, etc.) which live in the water and in the bottom of ponds.

By consuming these living organisms, fish can satisfy their protein requirements and, in order to maintain their optimal growth, they only need to be fed the relatively cheap, energy-rich supplementary feeds. Hence, one of the advantages of pond fish culture in comparison to the intensive fish production systems is that the protein requirement of fish is satisfied by the natural fish food* instead of using expensive sources of expensive fish meal.

INTEGRATED FISH FARMING

Polyculture is more relevant when integrated into well-established agricultural practices. Integrated fish farming systems may combine aquaculture with livestock or crop production, or the three components together.

In this system, substances that may otherwise be considered as wastes are viewed as resources out of place and contribute to an increase in fish production. Pond fish culture is suitable for the utilization of farm wastes such as manure from animal husbandry. These materials introduced in the water can support the development of natural fish food. Wastes from the milling industry and the by-products of crop, vegetable and fruit production can be used directly as fish feed. Consequently, agricultural activities which produce these by-products can be efficiently integrated with pond fish culture.

INTEGRATED FISH-DUCK FARMING

One of the best practice is raising ducks over fishponds. It fits very well with the fish polyculture system. In this system, duck can collect more than half of their food naturally from the pond and also can provide feed and fertilizer for fishes. Moreover, by doubling action ducks keep the water body clean and increase dissolved oxygen.

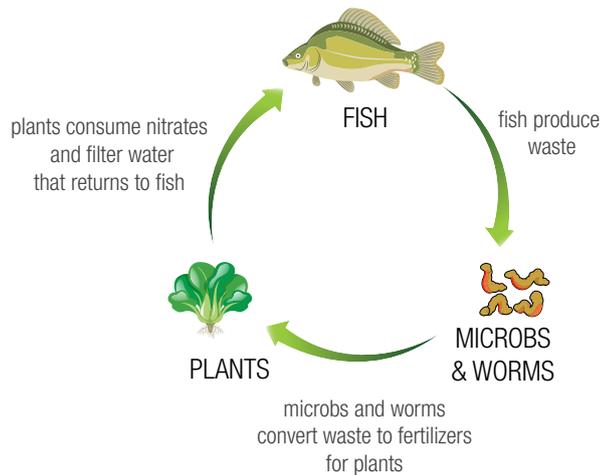
As mentioned above this pond generated only 50% of duck feed, the rest of duck-fish can be supply by rice bran and poultry feed. the protein content in natural food organisms of the ponds consumed by duck is high. Therefore, the duck reared in fishponds save the cost on protein substantially in duck feeds and gives more eggs in comparison to duck which is not allowed in fishponds.

In this integration, fish species selection is one of the important points, normally plankton feeder should be 60% and omnivorous should be 40%.



AQUAPONIC

Aquaponic is a sustainable method of raising both fish and vegetables with the same water that supports the fish. Aquaponic is a closed-looped system, in that plants filter the water to keep fish healthy, and, in turn, the fish effluent (waste) acts as a natural fertilizer for plant growth.



Nitrates are essential nutrients for plants. In aquaponic systems that there isn't soil, it is necessary to understand how the nitrogen cycle works. The Nitrogen cycle is the most significant process within aquaponic as it is responsible for the conversion of fish waste into nutrients for the plants, and without this process, the water quality would deteriorate rapidly and become toxic to both the fish and plants in the system.

In the process of nitrification, first fish excrete waste such as urine, fecal matter, and gills in the form of ammonia enter into the water in the next step microbes (nitrifying bacteria) in the system convert ammonia to nitrite and then convert into nitrates that can be absorbed easily by plants. As a result, Nitrogen compounds that are toxic to fish are removed from the water and become nutrients for plants that can help them grow.



SPECIES IN AQUAPONICS

The fish and plants that are used in an aquaponic system should have similar needs as far as temperature and pH. There will always be some compromise to the needs of the fish and plants but, the closer they match, the more success you will have.

HUMANE METHODS SLAUGHTER

Proper stunning renders the fish unconscious immediately and for a sufficient period of time such that the fish is killed in the slaughter process without regaining consciousness.

PERCUSSIVE STUNNING

It is known as knocking, percussive stunning involves hitting the fish's head with a wooden or plastic club, called a priest. However, applying this method correctly requires training and effort

PITHING

Pithing involves sticking a sharp spike through the brain of the fish. If done properly, it can kill quickly

ELECTRICAL STUNNING

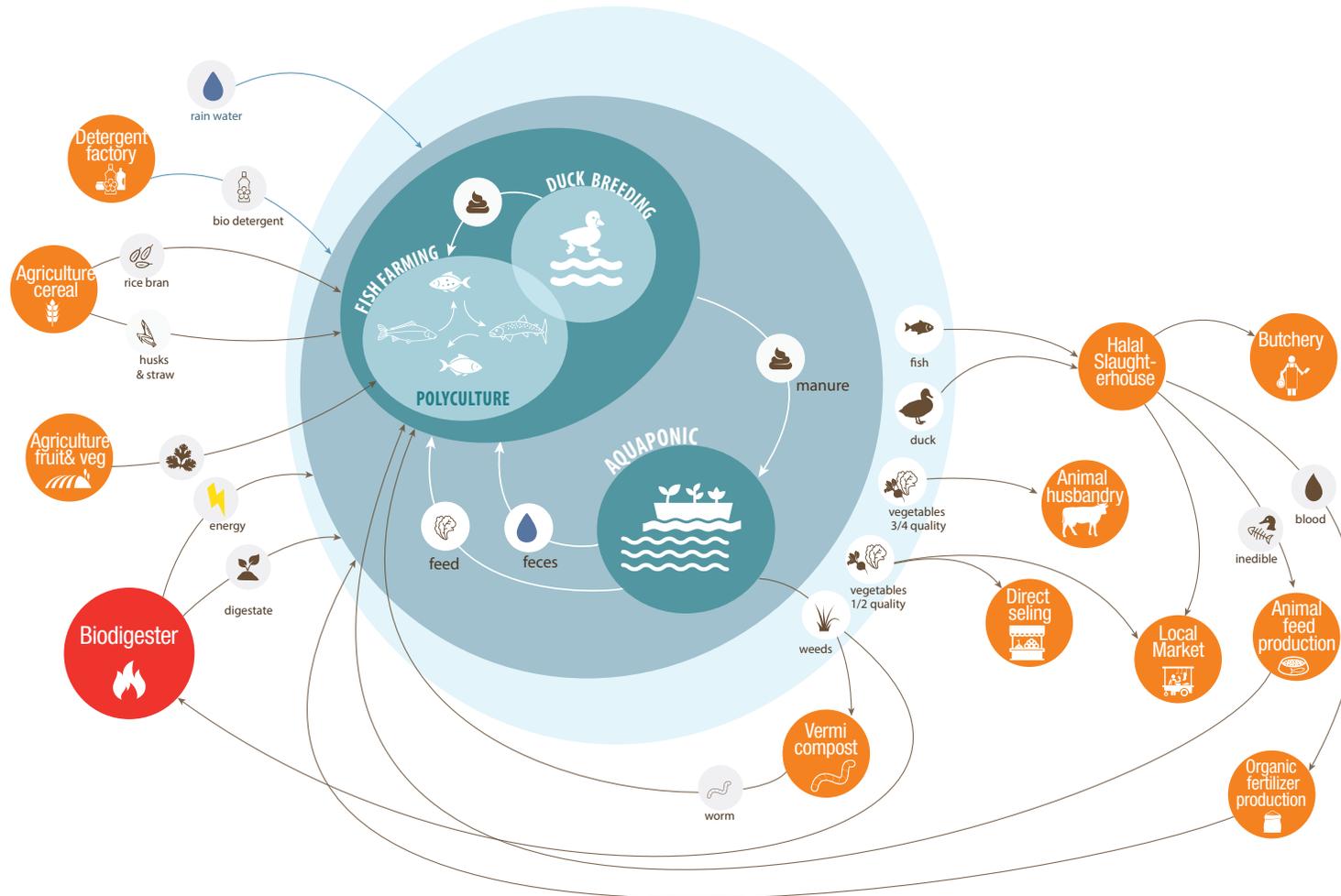
Electricity can be more humane than alternatives if applied correctly. In addition to potentially producing unconsciousness quickly, stunning reduces the stress of restraint and being removed from water.

OUTPUT MANAGEMENT

When fish is produced in combination with other farm products and livestock, centered around the fish farm. The system links each of the involved sub-systems in it, such as fish, crops, and livestock, in such a way that the waste or byproduct from one sub-system can be used as an input for the next system. This system can ensure the maximum utilization of all resources, such as land, water and feed, and also minimizes waste. Also, It provides the opportunity for increasing the range of products and increasing the profits of the fish farm.

FISH FARMING

SYSTEMIC



CURRENT

SYSTEMIC

Resource



Energy from net

Renewable energy from biodigester or wind turbine



Drinking water

Water from phytodepuration



Petrol

Biomethane from biodigester



Inputs



Imported Gm Eggfish

Self-production of Eggfish



Chemical Medicine

Ethnoveterinary medicine



Concentrated fishmeal

feed from local farm



Disinfectants

Organoc detergent



Chemical fertilizer

Manure from local farms



Outputs



Gray water



Water



Packaging Non recyclable



Packaging recyclable



Organic waste



Organic waste



1/2 Quality vegetables



3/4 Quality vegetables



Herb & weeds



NEW OUTPUTS

CURRENT



SYSTEMIC

Agriculture methods



MONOCULTURE



POLYCULTURE

Results



Competitive



Unfair prices



Environmental degradation



Uninformed Consumers



Human health risk



Cooperation



Fair prices



Preventing environmental degradation



Creating relationship between producers and consumers



Improving human health

COMPARISON

CURRENT SITUATION

As can be seen, in this territory a huge amount of food products such as meat, milk, fruit, legume and also substances such as pesticides, fertilizers are imported.

The majority of these products are industrial products that are imported from near and far regions and therefore intensively dependent on the logistics and mass market which means low quality and high price. In another hand, this region is an important zone for exporting some products such as rice, chicken and so on.

The most striking feature of the Current system is that some products that are produced and exported, at the same time are imported. For instance, many rice is imported from India and Pakistan with the Very low quality compared with Iranian rice.

This type of interaction causes a big loss in quality and also an unavoidable fluctuation in the price of the food and not only customers but also farmers will be affected by these fluctuations in this market.

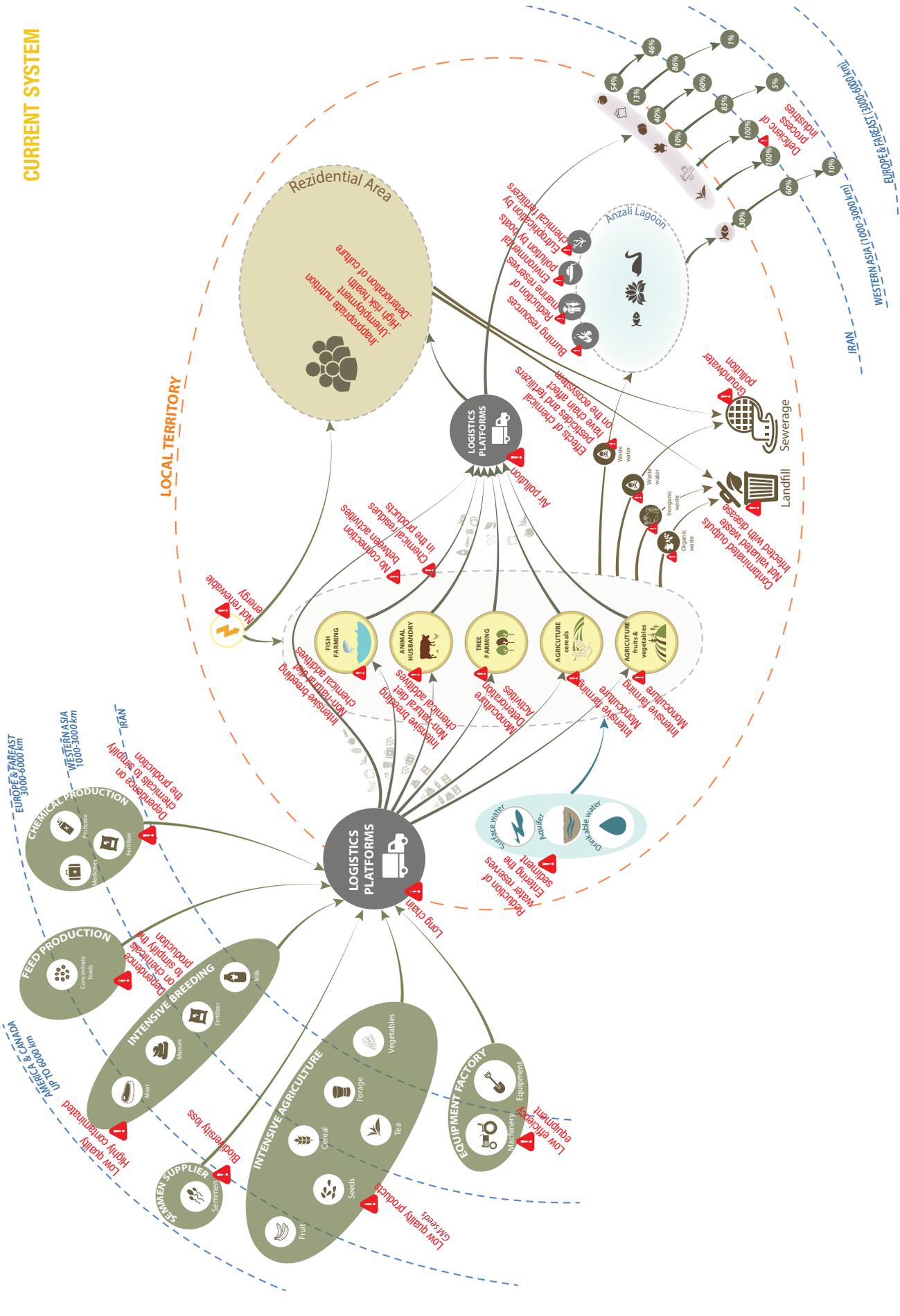
The high rate of importation has also created a competitive market for the local market and most of the industries have become bankrupt or are going into bankruptcy.

It would also be mentionable that long-distance transported makes a big amount of CO₂ emission.

Apart from imported products that don't have enough quality, In the same way, the food that is produced in the territory suffers from having enough quality.

Because of low revenues, farmers follow unsustainable method for increasing their products. A huge amount of fertilizer, pesticide, and genetically modified seeds are used in current agriculture in order to achieve the highest possible quantity. These practices threaten local resources and led to many negative side effect on the environment.

CURRENT SYSTEM



CONSEQUENCES

SOCIAL

The current system affects society in many ways. Firstly it threatens the human health. Contaminated food and water led to many diseases; According to the statistics, Gilan province is ranked first in the incidence of cancer.

Even though people in this region follow traditional food, but the raw materials which they used are always contaminated with chemicals and toxic or other additives that led to diseases and disorders in people. Unfortunately, most of them aren't aware of the healthy eating pattern.

The other effect is on the culture; The current system leads to deteriorating of culture. During the last decades, new technology has changed the production system completely from traditional to industrial; in this situation, many traditional methods and processing techniques are going to disappear. Moreover, many traditions, handicrafts that once were striking features of this area have been disappeared.

ENVIRONMENTAL

Unsustainable methods of agriculture led to many negative effects on the environment; Soil erosion, soil degradation, water contamination, eutrophication are the major issues associated with intensive farming; moreover in current system excessive use of natural resources led to depletion of them.

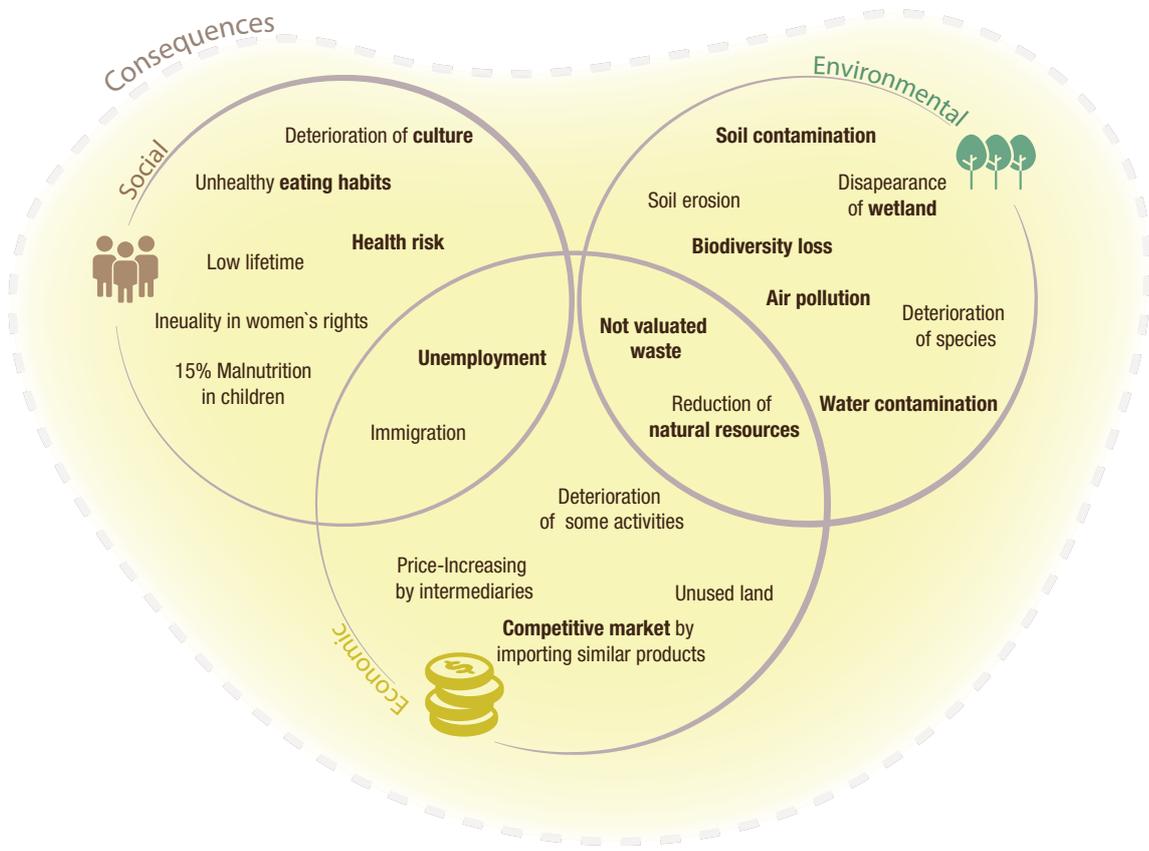
But above all, these unsustainable practices have a huge negative effect on Anzali wetland; During the last decades it has been degraded and reached to a critical condition and endangered many species in wetlands.

Apart from the above long distance transport affects air quality. The energy is most often supplied by fossil fuels, it causes a large amount of CO₂ emission which has a serious impact on the environment and health of the inhabitants of the territory.

ECONOMICAL

With a high level of imports, domestic manufacturers have encountered a lot of problems; The presence of imported goods and the tendency of people to buy cheap goods (even though with low quality) led to the deterioration of some activities. In this market, farmers earn only an insignificant amount of profit and the major part of it reaches to intermediaries and brokers.

These disappointing economic conditions cause the migration of a large number of people, especially Youth.



SYSTEMIC SITUATION

It can be clearly observed that in the systemic approach all the activities are connected to each other and therefore to the territory.

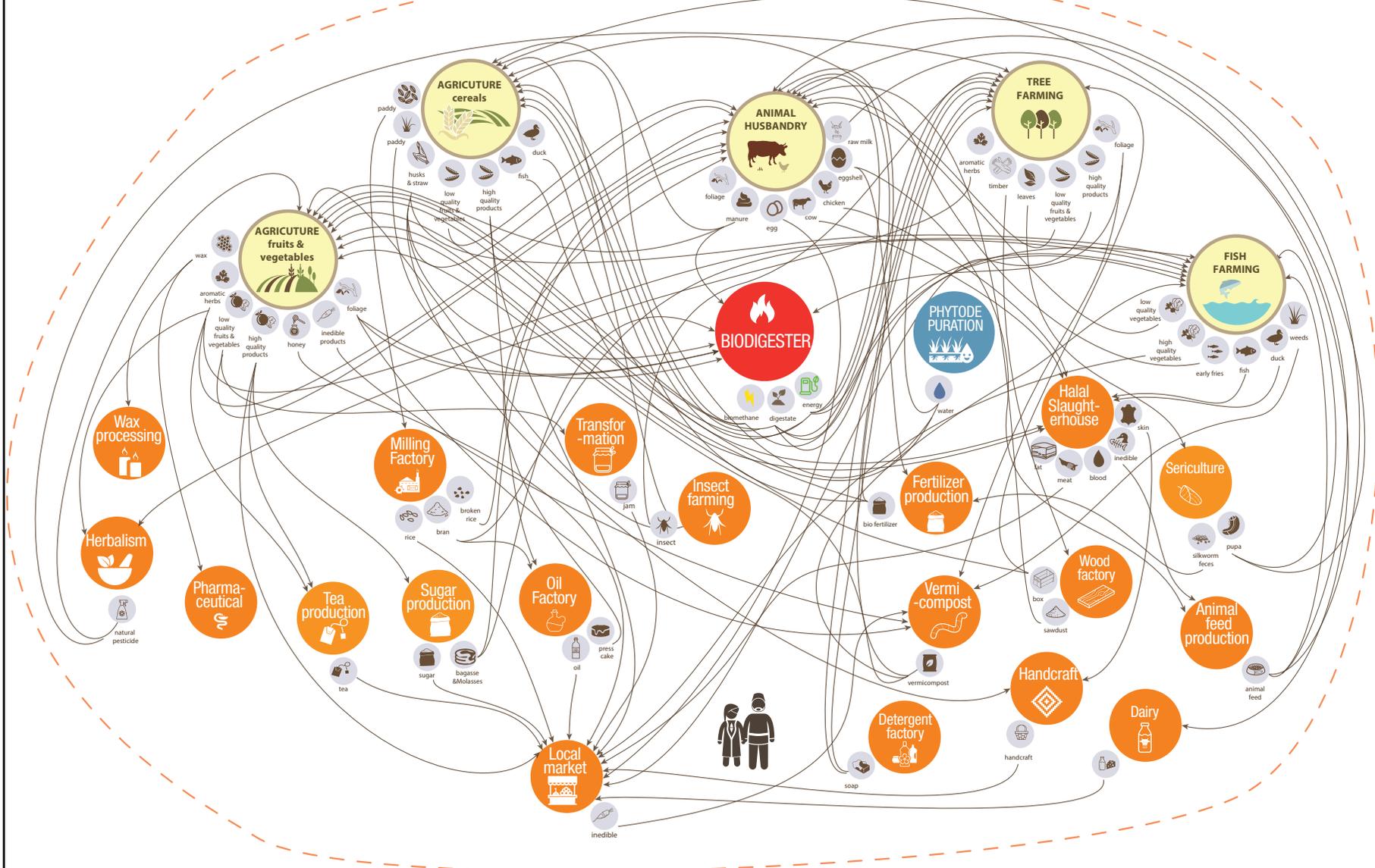
Local activities by cooperating with each other and territorial potentials fulfill the need of the citizens, therefore the importation of goods decrease, only in a few cases some products are imported from near cities.

Since the systemic approach is based on relation between outputs and inputs of different activities ;so each individual system by using sustainable methods try to achieve high quality outputs to guarantee inputs of other systems.

Practitioners of sustainable agriculture seek to integrate three main objectives into their work: a healthy environment, economic profitability, and social and economic equity.

Further more, because of local distribution network, all people include consumers ,distributer, producers and farmers can have an important role in ensuring a sustainable food system.

LOCAL TERRITORY



CONSEQUENCES

SOCIAL

In a new system, inhabitants are more aware of healthy eating habits ;As a result they have important role in society because they look for quality instead of the proportion of quantity and price and in this way they force farmers to have greater attention to the quality of their products and fulfill the nutritious need of the citizens .

Following the accepted pattern of consumption and choosing high-quality products led to better health conditions and increasing the Mental Health.

Customers also have more information about the origin of the products that they buy; in fact, with the presences of local markets, the customers are more connected to producers and local sellers that led to an increased trust.

ENVIRONMENTAL

Applying sustainable methods in different activities have many benefits for the environment. These methods are applied to improve the resources instead of degradation.

At the same time, due to the main reasons for the degradation of wetland are related to inappropriate techniques that are used in these activities. The new systemic approach can have a significant effect on the revival of the wetland.

Furthermore because this systemic insists on local food which is produced on the local territory and prevents huge transportation on the global logistic level, we witnessed a decrease in the co2 emission caused by food transport and global logistics platform.

Using renewable energy is another practice that applied in the new approach. The regional potential for solar and wind power generation can decline negative effects of fossil fuels.

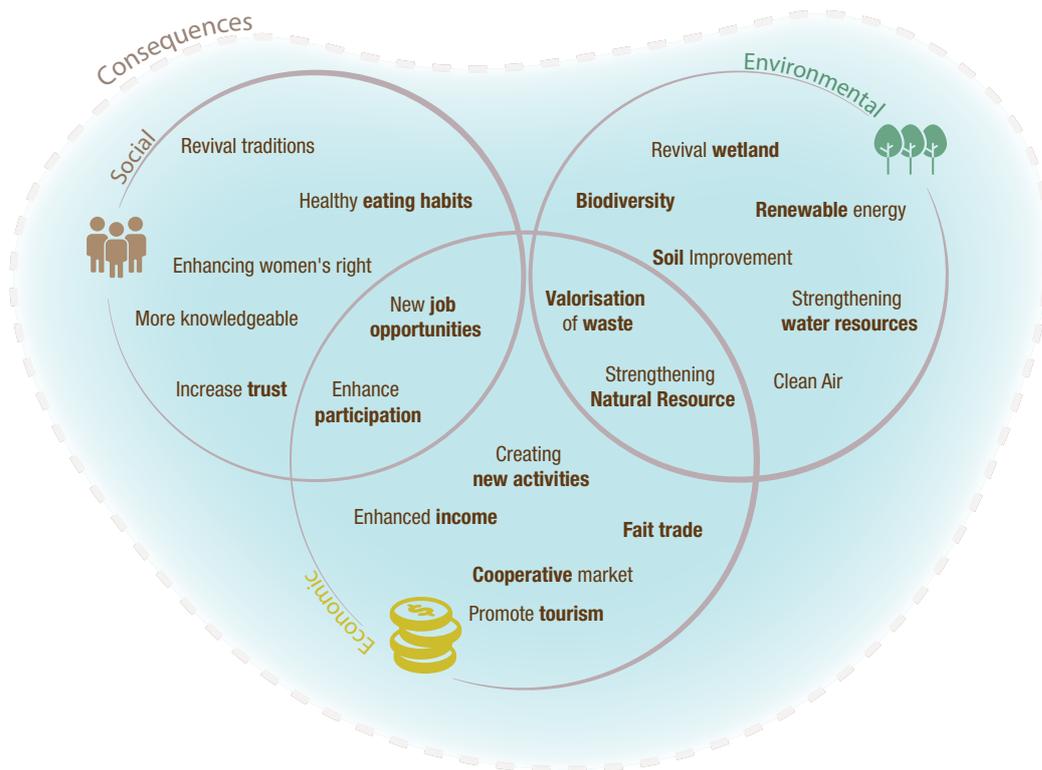
Finally, as the system is based on to make each of the waste and output to a resource and input to other activities, in this way many waste are valorized instead of environmental pollution.

ECONOMICAL

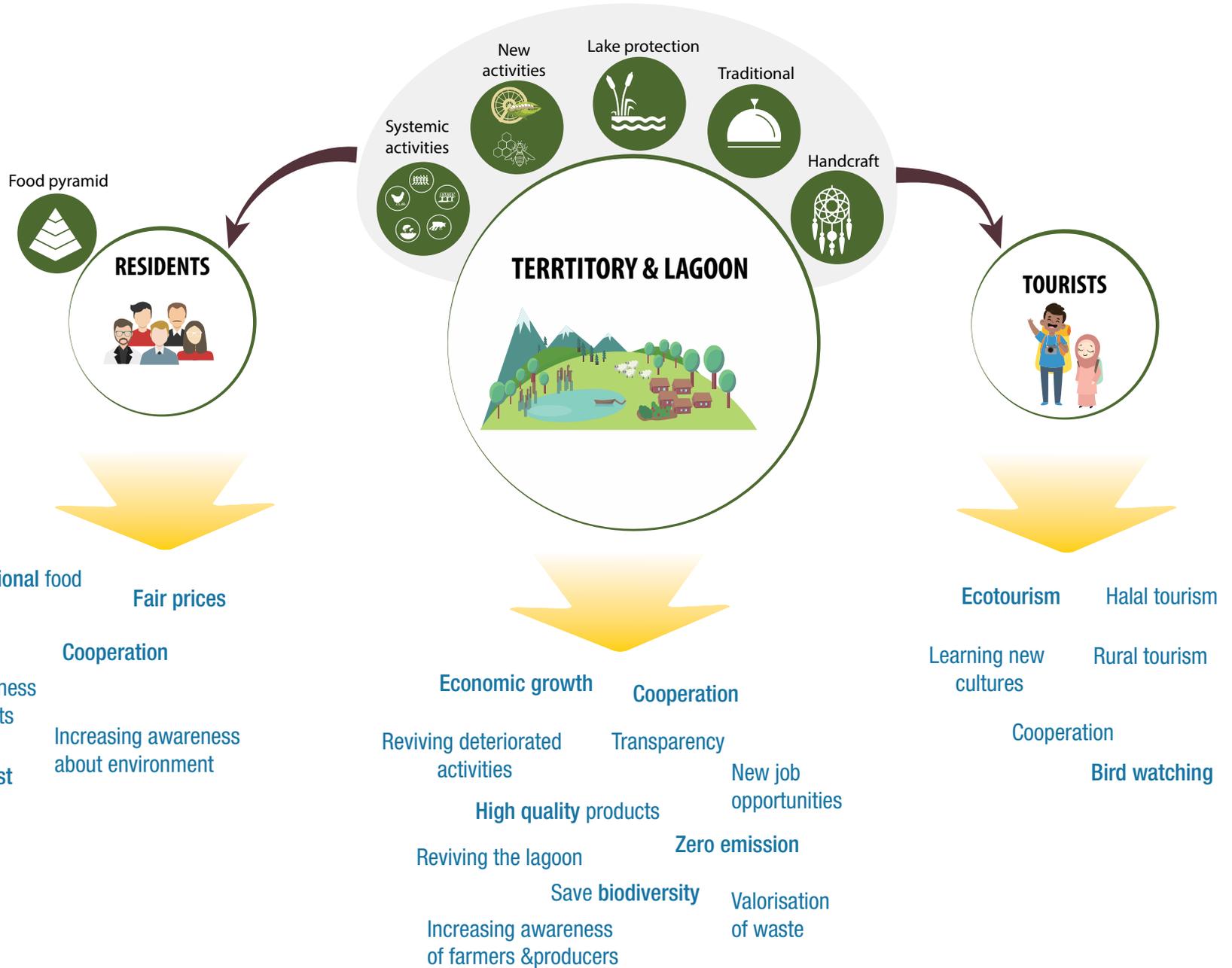
The systemic approach is based on cooperation instead of competition, The system is made out of the relations between activities based on the quality of the Output and the Input, while the output of each activity becomes input for another activity or system, a self generated system emerge; which brings a new type of economy.

Also in the new platform, the local distribution network connect sellers to buyers and therefore it makes the deals happen with the right price. In this way, both the producers and consumers are satisfied with the fair trade.

In addition, the valorization of waste and also new products generated by new techniques, improve the income of farmers and in some cases, it creates new job opportunities for residents.



CONCLUSION



NEW POTENTIAL

Nowadays tourism in this area is limited to summer and new year holiday in which people travel to visit Anzali wetland or shopping in free zone malls.

By implementing the Systemic approach, there will be new potential in the area for tourism.

As mentioned before, Anzali wetland is one of the best places that hosts some rare immigrated birds, in winter; however in the last years by degradation the wetland, it has faced a major drop in the number of these species.

By revival of the wetland and the return of immigrant birds, Bird watching tourism can be one of the tourism attraction of this place in winter. Creating sites for bird watching and workshops can help to improve this kind of tourism.

Culinary and Halal tourism can also be an attraction of this region, as it's known in Iran for its foods variety; there are about 170 kinds of foods in this region that most of them are adopted by other cities. So it can attract people to involve tasting and experiencing the local and traditional food of this district and also, as the foods are cooked by Islamic rules, halal tourism can be considered as a kind of the culinary tourism.

Above all of these features, this area has a unique culture and beautiful traditions that can be really interpreting for lots of propel. Lately, a lot of tourists gain interest in rural tourism, to watch festivals, celebrations, customs and different lifestyle can attract lots of tourists to this area. As can be seen, this area has a high potential for tourist attraction during all the year that can improve its resident's economic situation.

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