Iguana production: hope or scope?

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Iguana production: hope or scope?

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Abstract

Iguanas offer an opportunity to establish a balanced production system in which economically viable conditions for the smallholders can be realised together with conservation of the natural forest and production of animal protein. The objective of this study was to analyse existing iguana production systems in Nicaragua, Costa Rica and Panama as the basis for the design of an integrated iguana production system, taking into account various goals of stakeholders of the system, such as governments, Non-Governmental Organisations (NGOs) and farmers. The study yielded prospects and constraints for iguana farming and their implications for the system as a whole, the smallholders, the natural forest and the iguanas. To identify the problems and resolve conflicting goals among stakeholders, a soft system approach was used. Two stakeholder groups, Farmers and Organisations, discussed the production system. Organisations consisted of officials from government and NGOs. Discussions resulted in conceptual models, with which problems were identified and feasibility of possible solutions was explored. The soft systems approach proved to be adequate to identify prospects and constraints and their implications. The development of iguana production systems in Panama was compared at different phases of its development with the introduction of other new production systems of non-traditional species. The study revealed six key factors for introduction and development of new production systems. These factors could be distinguished by conditions that are needed to start a new production system: biology, support and market; and by limitations that can impede the development of new production systems: information, social conditions and legislation. Comparing key factors among production systems enabled us to explore the scope for development of production systems and their prospects and constraints. All key factors appeared negative for iguana production. In spite of the formation of farmers' associations and the exchange of information and experiences among farmers, advisors and other stakeholders, the diffusion of the production system will be constrained by lack of market opportunities for iguana products, lack of support and biological problems in iguana production.

Stellingen

1. It is possible to bring iguana farming from hope to scope (this thesis).

2. *De introductie van innovatieve productie systemen is universeel:* overal ter wereld lopen systemen tegen dezelfde problemen aan. Bij het invoeren van innovaties (bijv. biologische veehouderij) kunnen wij iets leren van de problemen uit de tropen (dit proefschrift).

3. Diegene die wil bijdragen aan het oplossen van de huidige problemen in de landbouw zal moeten leren om over de grenzen van de eigen discipline heen te kijken.

4. Agriculture is the art to cultivate the sun (farmer in Nicaragua)

5. The Bribri Indians believed they were owned by their God, as harvest is owned by the man who sew it. We are sons and daughters of our God, but we do not feel good in that position. Thus, we create machines to be owned by them and simultaneously destroy our world.

6. Whispering between neighbours in a meeting indicates that the discussion evolves poorly.

7. We geven automatisch aan iedereen die we op onze weg tegenkomen, maar we maken een bewuste keuze over wat we geven.

8. Gezien het grote aantal vaardigheden die nodig zijn om een proefschrift af te ronden kan de titel "Ph.D" met recht worden uitgebreid tot "(Ph&IT)D." (Doctor in the Philosophy and Information Technology).

Behorende bij het proefschrift van Karen Eilers: "Iguana production: hope or scope?"

Wageningen, 8 februari, 2002.

Errata: Page 35: The labels on the x-axis of Figure 2 are missing.

Figure 2. On-farm labour division

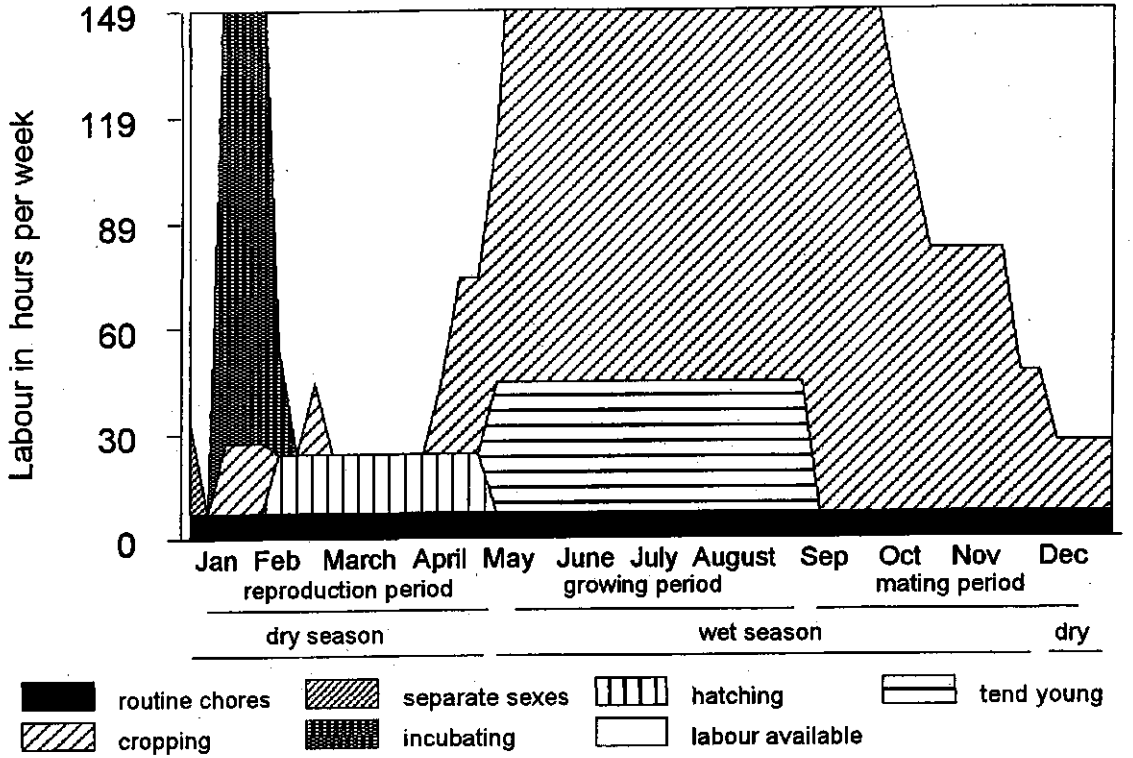

Figure 2. On-farm labour division

Voorwoord

Als ik op mijn aio-tijd terug kijk lijkt het net een lange reis. Eerst dien je een aanvraag voor een visum in met de vraag of je in het land van WIAS mag reizen. Wiebe Koops haalde me over om de reis te gaan maken en een visum aan te vragen. Zo'n visum aanvraag had heel wat voeten in aarde, maar uiteindelijk mocht ik het land der wetenschappers gaan bereizen. Er was wel een voorwaarde: je moest reizen onder begeleiding. Wiebe samen met Herman van Keulen, Jos Noordhuizen en Henk Udo waren mijn reisleiders. Ondanks mijn exotische reisdoel: het bestuderen van leguanen, waar geen van de reisleiders ervaring mee had, hielpen ze me met de planning, met de aanpassing van de reisopzet, met de verwerking van mijn ervaringen en de weergave daarvan in dit boekje. Heren, hartelijk bedankt!!

Door de exotische bestemming moest ik op zoek naar goede gidsen, die ervaring hadden met leguanen. Ik had het geluk om tijdens mijn reis in Nicaragua, Costa Rica en Panama enkele prima gidsen tegen te komen. Zij namen alle tijd om me het productiesysteem van leguanen nauwkeurig uit te leggen, brachten me bij de boeren en waren een prima reisgezelschap. Virginia Ríos, Augusto Gonzaléz, Fernando Esquivel, Jorge Cabrera y Vivienne Solíz muchas gracias por todo su apoyo, por acompañarme y enseñarme mucho sobre la tenencia de iguanas.

Wat op een reis altijd het belangrijkste is, is niet zozeer de reisbestemming, maar de mensen die je gedurende de reis ontmoet en waarmee je in gesprek raakt. Ik wist van tevoren niet dat ik zoveel interessante personen zou ontmoeten en dat zij me zoveel zouden leren. Ten eerste, wil ik graag de boeren in Nicaragua bedanken, die met veel geduld aan la Chela de Holanda hun leguanensysteem uitlegden. Zij waren en bleven zeer enthousiast, gastvrij en behulpzaam, ondanks hun problemen met droogtes, overvloed aan regens (Mitch) en ziekten. We hebben ontzettend fijn samengewerkt en Nicaragua zal ik altijd blijven onthouden als een land van doorzetters en filosofen (O Nicaragua, Nicaraguita). De leguanen boeren in León hebben nu een coöperatie: veel sterkte en alle succes.

Ook tijdens mijn bezoeken aan de leguanenbedrijven in Panama en Costa Rica heb ik veel geleerd, genoten en gehoord. Iedereen wilde graag zijn of haar ervaringen met me delen. Ik kreeg naast leguanenkennis dan ook heel veel cultuur, traditie en levensverhalen te horen. Iedereen hartelijk dank voor de schitterende ervaring. Ook heb ik andere volkeren leren kennen op mijn reis door de jungle. Gloria Mayorga en Juanita Sánchez wijdden mij in in de gewoontes van de Bribri-indianen. Met een kop koffie, schitterende legendes en veel grapjes brachten we tijd gedurende de stortbuien gezellig door en leerde ik wat het leven in een regenwoud-reservaat betekende.

Constant maar op reis, alleen en ver van huis. Dan moet je zo nu en dan even stoppen op een plek, waar je je verhaal kwijt kunt en je even weer een grote familie om je heen hebt. Twee families hebben mij opgenomen in hun midden en met mij lief en leed gedeeld. Damaris y Chico, mis tico-padres, Virginia y Augusto, quienes me hicieron parte de su familia con el honor de ser madrina de su hija, Kathy. Daarnaast kreeg ik veel vrienden, die met mij meereisden door wetenschapsland of waarmee ik samen op verkenning ging naar andere landen: salsa-land (Marcel, Heleen), wandel-land (Nienke, Gerda), kletsland (Paula, Leonie etc.) en zwemland (Annemieke). Mis amigos que me ayudaron a pasar mi tiempo libre acompañada: Aneo y Vanessa, Giovanna y Ingrid, Elisa, Juan-José y Analu, Gloria y Juanita, Edsart, Flavio, Luuk y Annemarie, Pascal y Monique. Niet te vergeten, Chantal en Marre, twee studentes die me hielpen door al discussiërend alle landen op een rijtje te krijgen en wiens reis naar de leguanen ook voor mij nieuwe ervaringen opleverde.

Tijdens een reis is steun van het thuisfront heel belangrijk. Achter het idee en daarna de reis staan, mailen, bellen en heerlijke avonden waarin ik mijn ervaringen in wetenschapsland en alles over mijn reisdoel kwijt kon. Lieve familie, jullie hebben me gelukkig niet hoeven te komen redden uit dat gevaarlijke Nicaragua. Bedankt voor jullie steun in Nederland en overzee! Lieve vrienden en medereizigers door wetenschapsland, bedankt dat ik altijd mijn hart bij jullie mocht luchten over alle aio-en andere perikelen. Mijn twee reis- en kamergenootjes, Ton en Erwin, bedankt voor de gezellige uren, heftige discussies en het functioneren als vraagbaak: succes met het bereiken van jullie eindbestemming.

En dan volgt de afsluiting van de reis met de verslaglegging. Daarbij ontmoette ik een reisleider, die me wees op alle valkuilen. Hij bracht me met eindeloos geduld de regels bij en steunde me in voor- en tegenspoed. Mike, I enjoyed your personal courses and I feel honoured that you spent so much of your time and energy in rewriting this "boekje" with me. Thank you!

Het wordt tijd om een punt achter deze reis te zetten en verder te gaan naar een nieuw reisdoel. Daarom un abrazo fuerte por todos mis compañeros (een omhelzing voor al mijn vrienden en medereizigers): op naar een nieuw reisdoel!

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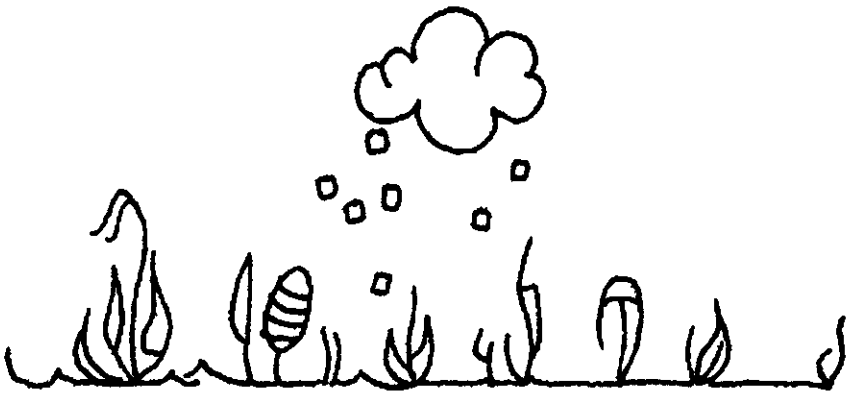

Legend of the armadillo and the iguana

Sibö has created everything in this world. One of his relatives is called PlékeköL, which means 'King of the Leaf-cutter Ants'. White people are relatives of PlékeköL; they have their origin in an immortal being. Indigenous people, however, have their origin in Sibö's maize seeds. They belong to Sibö; he is their owner.

Chapter 1

Introduction

1.1 Background

Farmers in Central America have limited possibilities to expand agricultural production to grow basic food crops through traditional techniques, such as slash and burn, because suitable land is already occupied. Moreover, these traditional production techniques are associated with continuous deforestation and soil erosion (Gradwohl and Greenberg, 1988, Buffa and Werner, 1989, Pérez, 1994). During the dry season, when their plots are fallow, subsistence farmers exploit the surrounding natural forests to support their family, e.g. hunting wild animals, collecting firewood, and extracting timber, wood and thatch to repair their huts (Gutierrez, 1996). This exploitation leads to forest degradation. Under current economic conditions, however, these unsustainable practices constitute virtually the only option for the resource-poor farmer to make a living.

Resource-poor farmers use small game animals as a protein source, because other protein sources, such as cattle meat, are too expensive (Vietmeyer, 1985; Werner, 1991; Féron, 1995). One traditional protein source is the green iguana (*Iguana iguana*). Iguanas have been important as a food resource since prehistoric times: they have been consumed for more than 7000 years (Peters, 1993). A Spanish conquistador in an account of the Mayas in Yucatan in the mid-1500s, remarked that iguanas are "a most remarkable and wholesome food. There are so many of them that they are a great support to everyone during Lent (a forty-day period before Easter, when Christians are used to fast and abstain from (red) meat). The Indians fish for them with snares which they fasten in trees and in their holes" (Fitch et al., 1982). Iguanas still are consumed throughout their natural habitat, the margins of the tropical rainforest from Mexico to Paraguay. Recently, they have been hunted to near-extinction, which is also associated with the destruction of their natural habitat, i.e. deforestation (Ruiz and Rand, 1981: Fitch et al., 1982).

In an effort to stop the process of deforestation, non-governmental organisations (NGOs) and government institutes in Central America have proposed to farm green iguanas as an alternative to traditional production techniques. Anticipated benefits of such a production system include: providing extra income for smallholders, conserving the natural forest, producing animal protein, increasing the number of trees to produce fuel wood, timber and fruits, and augmenting farmers' knowledge about nature (Pérez et al., 1993; Madrigal and Solís, 1994; Ruiz Rodríguez and Ascher, 1996).

The iguana production system may contribute to establishing a balanced situation, in which the expected goals, i.e. an economically viable situation for the smallholders, conservation of the natural forest and production of animal protein, might be realised concurrently. Re-establishment of multipurpose forests in agricultural areas provides tree products to the farmers (fuel wood, fruits, timber) and simultaneously protects the soil and water resources. Such production systems may lead to increased numbers of iguanas that can provide smallholders with means of subsistence and eventually a source of income from iguana meat, eggs and hides. Through implementation of the iguana production system, farmers would be able to satisfy their basic needs on their available land, rather than expanding that area at the expense of virgin forest.

General approach

It is difficult to design alternative production systems that contribute to solving the complex social and economic problems and that are readily adopted by the local population, mainly because it is difficult to take into account the goals and interests of different stakeholders in the development process. To explore the prospects for implementation of an integrated production system, while also taking into account the goals and interests of the stakeholders, existing iguana production systems in Costa Rica, Nicaragua and Panama were analysed. The analysis takes into account physical conditions of the production areas, technical coefficients of various components of the production system, objectives of various stakeholders (farmers, neighbouring families, government officials, extensionists and NGOs) and the (socio-) economic environment in which the systems are operating. The analysis should provide information for the design of a production system that can serve as an alternative for the current agricultural production techniques, within the constraints set by environmental and socio-economic conditions of the region and still meeting the different goals of various stakeholders.

Green iguanas are protected, and most of the existing iguana production systems are in an experimental stage. This situation provides an opportunity to explore whether an alternative production system, based on integrated forest and iguana management, could be introduced.

1.2 Objectives

The objective of this study was to analyse existing iguana production systems as the basis for the design of an integrated iguana production system, taking into account the different goals of governments and NGOs and of prospective users (e.g. farmers) of the system. The study should yield prospects and constraints for iguana farming and their implications for the system as a whole, the smallholders, the natural forest and the iguanas.

The research questions used to reach these objectives were:

- What are the advantages and disadvantages of the survey used to characterise and analyse recently introduced production systems?
- What social, technical, economic, ecological and legislative aspects influence iguana production in Nicaragua, Costa Rica and Panama? What are the conditions for existing iguana production systems in these three countries? What problems are encountered with producing iguanas in these countries?
- What are the perceptions of iguana farmers, neighbours and former iguana farmers on iguana farming as a system?
- What is the value of a visualisation method with 'cartoon' drawings used to obtain farmers' views on iguana production systems?
- What is the value of the soft systems approach used to design a new production system, taking into account goals and opinions of the stakeholders of the new production system?
- What are the prospects and constraints of the iguana production system?
- What is the value of the key-factor-analysis and Rogers' theory to analyse the development of new production systems?
- What general trends and trade-offs in the development of new production systems are identified and what are the implications for future introductions of new production systems?

All over the world, new production systems with non-traditional animal species have been and are being designed and introduced as alternatives for (or in addition to) existing agricultural production. Iguana production is one example of such a system with a non-traditional species. The methods used to study the introduction and development of this system in Central America might be applied to other new production systems. The iguana production system serves as an example of the development and performance of new production systems, identifying common prospects and constraints associated with the introduction of new systems and identifying solutions to problems encountered during introduction. The trends and trade-offs identified during the introduction and development of new systems can be taken into consideration when preparing for future introduction of new systems. These trends and trade-offs also can help to avoid disappointments of innovators by avoiding failure of introductions of new systems because of misinterpreted prospects and constraints.

1.3 Research methods

An analytical systems approach was followed.

Characterisation

Existing iguana production systems in Nicaragua, Costa Rica and Panama were described based on surveys covering all stakeholders. Various subsystems and components important to the iguana production systems were identified. Description of the systems also identified main gaps in knowledge, such as in the iguana subsystem (on-farm nutrition, reproduction and health of iguanas), in the forestry subsystem (production as affected by species composition, exploitation and environmental factors), and in the smallholder subsystem (production data, input/output relations).

Analysis

Boundaries of the system and of the various subsystems were characterised. Respondents identified the relevant relations among the subsystems and among the elements within each of the subsystems with emphasis on the iguana production subsystem. They also identified conditions for iguana production and the problems experienced with iguana production. The system was analysed with these relations among the elements, conditions and problems.

Design

To identify the various objectives of different stakeholders and to examine the extent to which these objectives can be realised, stakeholders were invited to give their opinions on iguana production, its prospects and constraints. Stakeholders discussed and evaluated the various constraints of iguana production systems with respect to their long-term implications for the system as a whole, the smallholders, the natural forest and the iguanas. During the discussion, a conceptual model of the iguana production system was designed, comprising the important elements, its prospects and constraints. Stakeholders used the conceptual model to identify options for development and formulated recommendations with respect to continuation of existing iguana production systems.

Feasibility study

The newly designed conceptual model was compared with other new production systems of non-traditional animal species, such as deer in New Zealand or vicunas in Bolivia. The introduction of these new production systems was studied with a survey of experts, who were asked about the process of development of new production systems and the problems encountered during introduction. General trends and trade-offs in the development of new systems were identified, and these trends and trade-offs could help to explore the possibilities for the introduction and development of iguana production systems.

The biology of *Iguana iguana*, the species used in this production system, defines prospects and constraints for this system. Chapter 2 describes the habitat, feeding habits, thermoregulation, behaviour, predators and diseases, and most importantly the reproduction cycle of the iguana. In addition, the products of iguanas and the introduction of iguana production systems are discussed as the basis for an assessment of the possibilities to start iguana production and to understand the technical problems experienced on-farm.

After the introduction of iguana farming by NGOs, 24 iguana farms were dispersed throughout Nicaragua, Costa Rica and Panama (Chapters 3 and 4). Chapter 3 describes the social aspects of iguana farming, such as its labour requirements, and the technical aspects, such as housing systems and the three reproduction methods used in these countries. The conditions necessary for successful iguana farming and the problems encountered in iguana farming also are described.

Chapter 4 discusses the economic, ecological and legislative aspects of iguana farming in Nicaragua, Costa Rica and Panama. Economic aspects include the initial investment and the market. Ecological aspects include stimulation of nature conservation, awareness of the importance of protecting iguanas and knowledge about nature conservation aspects of iguana farming. Legislative aspects include the protected status of iguanas and the permits needed to farm and trade them.

Chapter 5 describes the views of respondents in the survey on iguana farming as a system. The respondents identified the important components of the iguana farming system and the important factors influencing the system from outside. The respondents' views were obtained through a visualisation method, especially useful for illiterate respondents or respondents with a language that differs from the mother tongue of the interviewer.

Chapter 6 describes the approach of iguana farmers and other stakeholders in iguana farming and their views on the system, its problems and possible solutions. Using participatory research methods, the different stakeholders met, exchanged experiences and views on the system and started co-operating to improve iguana farming.

Iguana farming is a specific case of the introduction of a non-traditional species for farming. Chapter 7 compares this case with other non-traditional species introduced in different countries so as to identify trends and trade-offs in the development of such a new production system. Can different species be compared? Do new systems face similar limitations? Were the stakeholders able to overcome these limitations?

Chapter 8 discusses iguana farming and the research on the introduction of new production systems.

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In the time of the creation of the indigenous people, Sibö kept the maize seeds in a basket. He was looking after them very anxiously because with these precious seeds the first indigenous people were to be created. In this period, the animals were like persons. They were helpers of Sibö, and they were working hard to prepare the earth in which soon the maize would be sowed.

Chapter 2

The green iguana

2.1 The appearance of the green iguana

Green iguanas are reptiles that have a long tail, eyelids, four legs, a dorsal crest and a dewlap (Figure 1). The skin of green iguanas is hard and scaled, protecting them against injuries and loss of water. Because the scales are not flexible, iguanas have to change skins (remove the old skin) to be able to grow. The colour of young iguanas is bright green, but during their first year their colour changes to dull, dark green. Their camouflage colours give them the ability to hide among the foliage of trees. Iguanas with a length smaller than 26 cm are considered to be immature, and distinguishing their sex is difficult. Immature males mostly are identical to females in their behaviour and external appearance. The colour of mature iguanas is sex dependent: the colour of mature males with a territory intensifies during the breeding season and varies from bright gold to red-orange. Males are larger than females, have a larger dewlap, a larger head, longer spines on the dorsal crest and larger femoral pores. The long pendulous dewlap is used for display behaviour and increases the visibility of long distance signals (Dugan, 1982; Dugan and Wiewandt, 1982). Iguanas can reach a length of 1.8 meters. Longevity for green iguanas in nature is estimated to be less than 10 years, and in captivity 15 to 20 years (Dugan and Wiewandt, 1982).

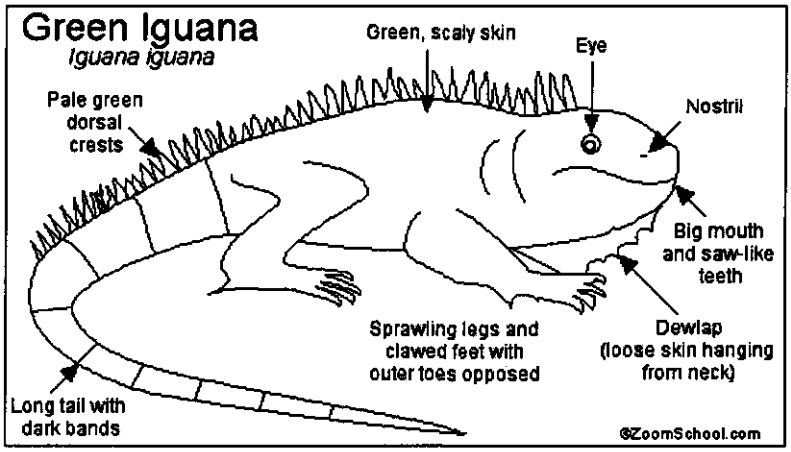

Figure 1. Appearance of the green iguana.

2.2 Classification and taxonomy

Green iguanas are reptiles. They belong to the Class *Reptilia*, Subclass *Lepidosauria*, Order *Squamata*, Suborder *Lacertilia* (lizards) and to the Family of the *Iguanidae* (Pough, 1979). *Iguanidae* species that eat only plant material are *Iguaninae*, to which group the green iguana belongs. Linnaeus described the green iguana *(Iguana iguana)* first in 1758. In 1834, Wiegman described two subspecies of *Iguana iguana*: the *Iguana iguana iguana* and the *Iguana iguana rhinolopha*. These subspecies differ in the enlargement and alignment of the median scales on the snout (Figure 2 and Figure 3) (Etheridge, 1982). Biologists in favour of distinguishing two subspecies assume they also differ in other aspects. Both subspecies are prevalent in the area in which research for this thesis was conducted (Figure 4).

Figure 2. *Iguana iguana iguana*

Figure 3. *Iguana iguana rhinolopha*

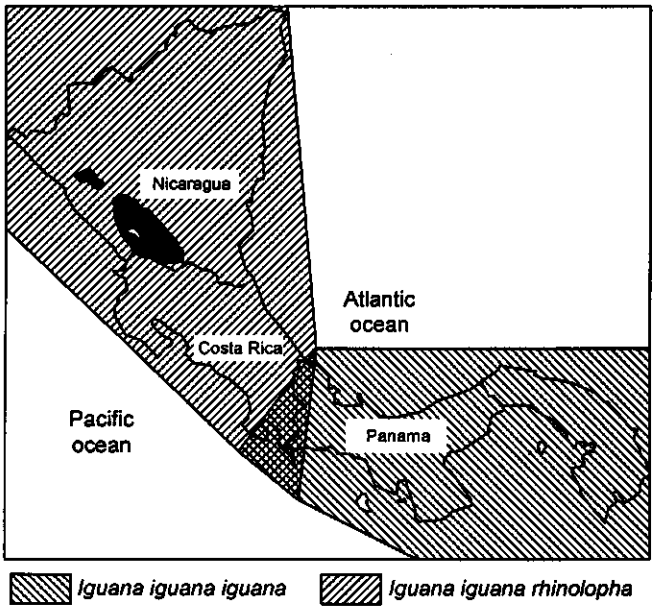

Figure 4. Theoretic map of the distribution of subspecies *Iguana iguana* in Costa Rica

2.3 Habitat of green iguanas

Green iguanas range on the American mainland from northern Mexico southward, through Central America and South America, at least to the Tropic of Capricorn in Paraguay and southeastern Brazil, including the coastal South and Central American islands and the Antilles. Green iguanas have been found in altitudes as high as 1000 meters (Etheridge, 1982).

Iguanas are primarily arboreal and strongly heliothermic. Their habitat requires trees and basking sites. Iguanas usually are well camouflaged and hard to see in the habitat. Iguanas remain in the treetops, except for occasional descents to the ground to bask, for tree-to-tree movement, for escape from disturbance, and for females travelling to nest sites. Favourite areas are trees with thick foliage and exposure to direct sun, found mostly near riversides or forest edges. Riversides are preferred, because there the iguanas can drink the water, have a good view, and at the first sign of danger jump into the water, dive and hide themselves from predators. An iguana might stay in the same location from one day to several weeks. A single tree could meet all of an iguana's short-term requirements: food, thermoregulatory sites such as basking sites and shade, sleeping perches and display posts (Dugan, 1982).

Green iguanas can shift their centre of activity for several days or weeks. They can travel through a large area (0.25 ha), moving from tree to tree, over the course of several months. Long-range movements are prompted, at least in part, by local changes in availability of food. Iguanas follow the seasonal fruiting and flowering pattern. During the fruiting period of the wild plum (*Spondias mombin*), for example, trees bearing plums could contain 10 to 15 animals. Large groups of iguanas also are present in vine-bearing trees late in the dry season (March and April in Central America), when many of the trees are leafless. After these periods of aggregation, the large groups disperse when new food resources become available (Dugan, 1982).

2.4 Thermoregulation

Green iguanas are ectotherm, so they depend on the sun to obtain energy and to maintain their body temperature. This has several consequences if iguanas are to be incorporated into a production system. They need sun and shade to regulate their body temperature. Their activity and mobility depend on their body temperature and thus on the temperature of the environment. If the environmental temperature is low, for example on rainy days, iguanas become lethargic; they cannot digest feed and they do not grow, but they also do not need much energy for maintenance. Their activity (feeding and moving) starts with a body temperature over 30°C. Smaller iguanas warm up more rapidly than larger ones, so they become active earlier in the morning than

larger iguanas. Because of their dependence on the environmental temperature, it is especially important for iguanas to restrict energy expenditures. To optimise their energy use, therefore, green iguanas are sporadically active. They normally spend over 90% of their waking hours lying or sitting motionless. Even during the mating season, green iguana males are inactive approximately 80% of the time (Dugan and Wiewandt, 1982). During these inactive periods, in which they have a relatively high body temperature, however, they are quiescent and alert, not lethargic.

2.5 Feed

Iguanas are herbivores. Even hatchlings with some yolk left in the intestine feed on vegetable matter. The smallest iguanas feed heavily on flowers, which is not a major food item of larger lizards. Iguanas of all sizes feed primarily on leaves. Young iguanas eat young leaves with a high nutritive value and with few fibres. Older iguanas also eat mature leaves. In addition to leaves, larger iguanas, especially, eat fruits (Werner and Rey, 1987). This vegetarian diet seems easy to supply, but iguanas are browsers, which means they select their diet according to their need. In the wild, for example, they eat plants occasionally that are toxic in large amounts; in small amounts, however, the plants act as an antiparasitic treatment.

Because iguanas are ectotherm, they do not need feed to maintain their body temperature. For example, they require about 6% of the energy for maintenance of a rodent and only 3% of that of a bird having the same body mass (Nagy, 1982). Lizards and mammals are made of similar kinds of tissues, and their anatomies are generally comparable. A lizard and a mammal of the same size, therefore, should be able to consume about the same amount of food at one time. Because of their intrinsically higher metabolic rate and daily body temperature regimes, lizards should be capable of obtaining more surplus energy (relative to the energy required for maintenance) than mammals. This capability suggests that lizards can invest a greater proportion of assimilated energy in growth and reproduction. In fact, ectotherms in general channel a larger proportion of their assimilated energy into production of new biomass than do mammals (Nagy, 1982). The feed an iguana uses to reach a marketable size costs no more than the feed a chicken uses to reach a marketable size, although iguanas need three years to reach that size, compared with six weeks for chickens (National Research Council, 1991). To keep iguanas in cages till they reach a marketable size, however, is too costly. Releasing them in the forest and harvesting them after they have reached the marketable size, therefore, seems feasible (Werner and Rey, 1987).

Iguanas grow efficiently but slowly, because they face temperature constraints during the rainy season. Like all herbivores, iguanas ferment their feed. Their colon is "specialised" in bacterial fermentation. These bacteria need a temperature above the

27°C to degrade the plant material. If the iguana has a lower body temperature, the bacteria do not contribute to fermentation. During cold periods (nights and rainy days), feed needs three times more time to pass through the digestive tract than during warm periods. Thus hatchlings and juveniles hardly feed on cool rainy days. For hatchlings, conditions for processing feed are not optimal in the rainy season. Because of the temperature constraints, iguanas feed irregularly. If they do not experience these constraints, and thus are not lethargic, they may feed every day (Distel and Veazey, 1982).

2.6 Behaviour of green iguanas

Most iguanas are found as singles or in small groups. Some iguanas, however, appear in large groups (7-13 iguanas). In aggregation, it is not unusual to observe two large males in the same tree at the same time. They never remain in the same location for more than a day, however, and they mostly avoid interaction with each other. Medium-sized males avoid large males at all times. Large males display more than medium-sized males. Only large males have access to conspicuous perches used as display posts and basking sites. The large males are more likely to be found close to one or more females than are medium-sized males. Encounters of large males with smaller males are usually brief and may function to establish dominance hierarchies (Dugan, 1982). The ability to aggregate means that iguanas of different ages (from 1 year to adults) can be kept together in one cage.

Although green iguanas are sporadically active, they do have a comprehensive social behaviour. Display behaviour, for example, occurs from a raised perch in a tree with a broad view. To display the green iguana extends the dewlap and moves the head with head-nods. The head-nodding display usually is performed at a low level of excitation. Both sexes, but more often males than females, perform head-nodding displays. The stereotyped head-nodding pattern is species-specific to the green iguana, and individual differences exist in the performance of stereotyped displays (Distel and Veazey, 1982). An iguana can react to display behaviour by closing its eyes, possibly to shut out an unpleasant stimulus, thereby allowing it to refrain from further reaction to the display behaviour (Distel and Veazey, 1982).

Combat fighting between males rarely has been observed in the field, in contrast to in the cage, probably because the challenged male was able to retreat. In the cage, however, three phases of combat fighting occur. The first phase is displaying, which means the male struts, circles the challenged male, and hisses and lashes his tail, with his dewlap and body maximally displayed. The second phase is when the challenging male pushes the challenged male who leans back. The third phase is when the challenging male mounts the attacked male and tries to bite its neck. When the

challenging male succeeds to bite, the bitten male flees violently (Distel and Veazey, 1982).

Defence behaviour

Iguanas freeze their on-going action in response to noises or to novel movements in the environment. They may continue their action later or they may perform tongue-flicking or scanning movements. If the stimulus persists, the iguanas may retreat eventually, e.g. by sliding behind a branch they were sitting on. Sometimes, iguanas arrive at a state of tonic-immobility. Long periods of freezing are often followed by a sudden violent flight. Because of this defence behaviour, iguanas need a quiet place for their cage. Places near a village, a school or a busy road, therefore, are to be avoided. In addition to this behaviour, defence against predators or other iguanas may involve lunges, snapping and catching, combined with head-shaking (Distel and Veazy, 1982).

2.7 Reproduction cycle of green iguanas

The reproduction cycle will be discussed extensively, because it is the driving force of iguana production and it appears to be one of the bottlenecks of a profitable iguana farming system. Female iguanas attain sexual maturity two to three years after hatching, and then reproduce regularly for three or more years, until death. Iguanas are oviparous and lay their eggs once a year. The reproduction cycle is divided into a period to obtain *territory*, a period of *mating* (copulation), and a period of *egg laying* activities, starting with the *incubation* period and ending with *hatching*. Different reproduction cycles can be found in the different climatologic zones (Figure 5).

The main factor determining the reproductive cycle of green iguanas seems to be availability of food for hatchlings. Hatchlings, like adults, are strictly herbivorous (Rand, 1978; Van Devender, 1982). Plant production, and thus availability of food, is related to rainfall. The onset of the rainy season provides sufficient water to initiate the production of young leaves. Throughout the habitat, hatching usually takes place early in the rainy season, whereas mating and egg laying usually occur in the dry season (Figure 5) (Rand and Greene, 1982). In Panama, the first major peak in leaf production occurs at the beginning of the wet season and hatching of eggs coincides with flush foliage production (Rand and Greene, 1982).

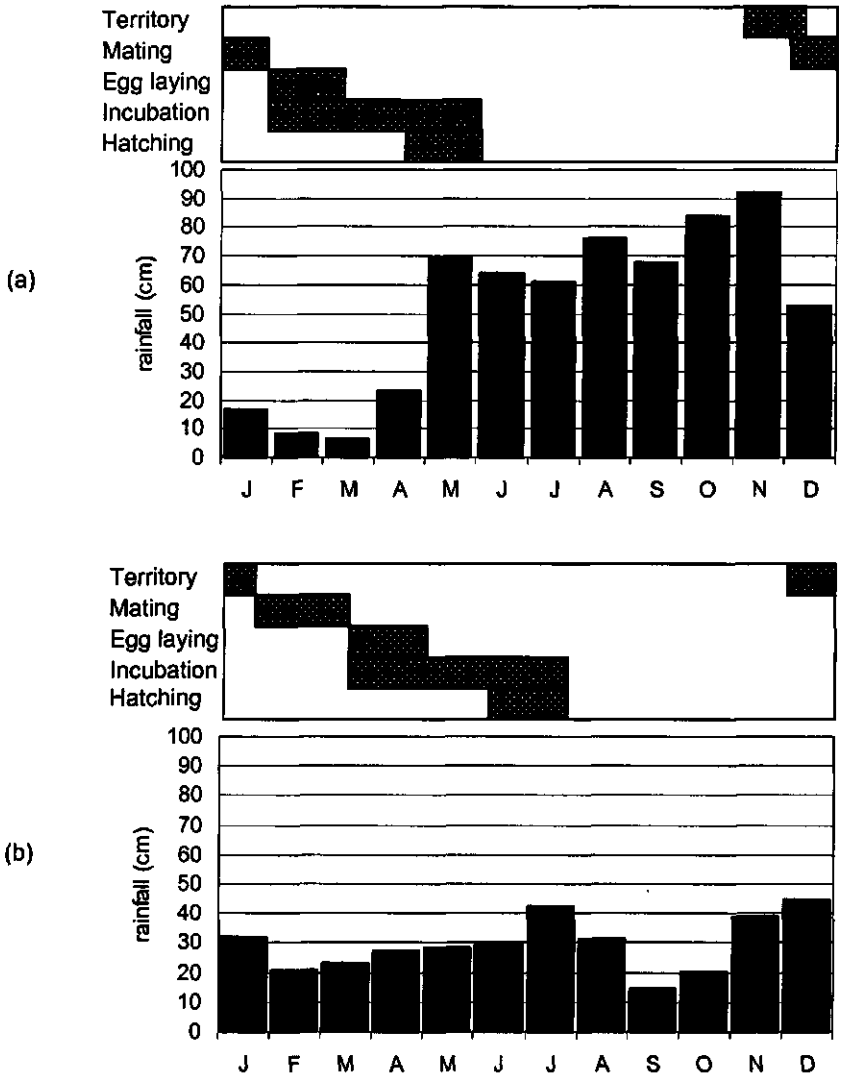

Figure 5. Pacific zone, with tropical savannah climate and a distinct dry season (a); Atlantic zone, with tropical rainforest climate and rain year-round (b).
The horizontal bars represent the different periods of the reproduction cycle.
Source: Gloria Mayorga (personal communication) and Van Marken Lichtenbelt, 1991.

Territory

Large males establish temporary mating territories. In regions with a distinct dry season, most large males establish territories by late November (Figure 5). A mating territory provides an undisturbed place within which to court and mate. Mating sites are objects

of male-male competition. Males, therefore, prefer tall conspicuous trees that have limited access (little canopy intertwining) and that are relatively easy to defend. Tall, dead trees are used frequently. Food may or may not be present in the territory (Dugan and Wiewandt, 1982). During the establishment of territories, large males do not allow medium-sized males to be in the same trees (Dugan, 1982).

Breeding of iguanas is annual and seasonal, with mating taking place in male territories three to seven weeks before egg laying (Figure 5) (Wiewandt, 1982; Van Marken Lichtenbelt, 1991). Males are able to spend longer periods on exposed display perches during windy periods than they can during still periods. These windy periods occur most frequently during the dry season. Thus the windy periods coincide with the mating season, when dominant males spend long hours displaying, patrolling, and mating in open, conspicuous display areas, i.e. the territories.

Polygyny is extreme, with a 1:1 sex ratio; about 60% of mature males do not breed (Dugan, 1982). One large male with a territory can mate with about five females. Competition between males over the territories is high and takes the form of increasing display rates to announce that the territory is occupied and of inviting females to join them (Dugan and Wiewandt, 1982). After late November, large males rarely feed; by late December, they appear to be emaciated (Dugan, 1982).

Mating

Courtship behaviour of males is seasonal and begins well ahead of copulation, even before females have taken up residence in a male's territory. Courtship appears to be an important factor in a female's choice of a mate, in facilitating female receptivity, and in establishing bonds of familiarity between mates (Dugan, 1982). Males court females for at least four weeks before the females become receptive. Female green iguanas are receptive for at least 15 days, and their receptive periods are spread over a six-week period (Dugan, 1982). Females prefer to mate with large males (Dugan, 1982; Rodda, 1992).

Multiple copulation of females is common in green iguanas. This behaviour can have three reasons: the cost to the female of rejecting males exceeds its advantage (Dugan and Wiewandt, 1982), females increase the genetic variability of their offspring and diversify their reproductive investment, and females attempt to assure adequate fertilisation. The cost of rejecting males may apply to females that are "overcome" by small males (Dugan, 1982), but does not account for multiple copulation with territorial males that females readily allow. Insuring fertility is particularly important if males mate many times during a short breeding season, because males are restricted to only one copulation a day.

Multiple mating strategies are found among green iguana males (Dugan, 1982; Rodda, 1992). Large males establish a territory, court females and copulate with them. Outside the territory period and mating period, the males stay within their confined home range and maintain their head bobs. In this way, they have close contact with females passing through the area, insuring access to a mating territory and reducing the dominance struggles with other large males (Dugan, 1982). Medium-sized males remain on the boundaries of territories monitoring the activity of the breeding group. Most medium-sized males do not mate opportunistically. Similarity to females in size and colour allows a small male to remain in or near breeding adults without being challenged, to monitor the activities of the group and to breed opportunistically (Dugan, 1982).

Egg laying

Eggs of iguanas are produced in the ovaries, where they grow and collect yolk until the fertilisation. After fertilisation eggs enter the oviducts, where the shells are formed and the embryos start to develop. At nesting, the embryo is 5 to 15 mm large (Werner and Rey, 1987).

Females with eggs have little space in their stomach to eat and they are slow. They descend from the trees to search for nesting sites. Some females travel for kilometres to find a suitable nesting site. During this period they are easy to catch. They are hunted for their eggs, and as a result they are almost extinct in several areas in Central America (Werner and Rey, 1987).

Females select nesting sites on the ground. The soil has to be in sunlit areas and soft enough for the female to excavate burrows. Each burrow is more than one meter in length. The burrow terminates in an egg chamber that lays 30 cm to 95 cm beneath the surface and that is wide enough to permit the female to turn around inside. The female lays only one clutch and then blocks the passageway to the eggs. The nesting sites are vigorously defended against other females during preparation of the nest (Wiewandt, 1982).

The numbers of eggs vary with the climate, the length of the female, and the number of clutches laid. In Panama with its tropical rainforest climate, the mean number of eggs per female is 41 per year (range 9 to 71) (Rand, 1984; Miller and Werner, 1987).

Incubation

Incubation of eggs by iguanas usually requires 10 to 14 weeks. The higher the temperature of the nest, the shorter is the incubation period. Temperature of the nest is nearly constant, averaging about 28°C to 32°C (Wiewandt, 1982). The relative humidity of the soil averages about 10% to 15% (Werner, 1988). Temperatures above or below

these values cause deformations of the hatchling or even failure to hatch. Mating and hatching are usually timed so that eggs incubate when the soil is appropriately warm, moisture is sufficiently available, and there is little risk of water-related mortality, e.g. flooding of the nest (Rand and Greene, 1982). In humid areas, such as Panama, flooding of the eggs is one of the major causes of embryo mortality. In the rainy season is the risk of flooding high and therefore is that season unsuitable for incubation. In addition to the high risk of flooding, the rainy season brings a drop in soil temperatures below 28°C, because of low air temperatures, and only few hours of sun. In Panama, soils in clearings reach 28°C only during the dry season.

Hatching

In nature, the hatching percentage of iguana eggs can vary between 0% to almost 100% (Rand and Dugan, 1980). The hatchling stays in the egg 10 to 20 hours, with only its head outside. It absorbs the rest of the yolk as feed for the next week, and develops strength enough to dig a tunnel, leave the nest and travel to a favourite habitat.

Hatching occurs with the onset of rains, when new leaves are available as feed for young iguanas (Rand and Greene, 1982). Young iguanas are folivores and, because they are small and growing rapidly, probably need better quality feed than adults do. In addition to the availability of young leaves in the rainy season, the rain soaks the soil around the nest and makes it easier for the young iguanas to dig their way out of the nest (Dugan, 1982).

In Panama, hatchlings emerge over a three-week period in May, and all depart the nest-site rapidly. The principal function of rapid dispersal might be to remove vulnerable hatchlings quickly from a zone of high risk and to distribute the hatchlings more widely over suitable habitats so as to reduce predation and increase resource availability (Drummond and Burghardt, 1982).

Iguanas are rather sedentary. The usual pattern of iguanas is to restrict their activities to a small area and to move to other areas from time to time. Some of these movements from one area to another are as far as 200 m. Hatchlings are deliberate in their movements and spend most of their time in green vegetation, where they can escape predators passively by camouflage and immobility. Young iguanas choose night perches on low branches and are often in groups. It is common to find 10 to 20 young iguanas in a space of only several square meters, often in close physical contact with each other. Aggregations of iguanas are most common at the time of emergence from the egg (Van Devender, 1982).

2.8 Predators of green iguanas in different stages of life

Eggs

In nature, eggs are eaten by four-eyed opposums (*Philander opossum*), ring-tailed coatis (*Nasua nasua*), common opossums (*Didelphis marsupialis*), river otters (*Lutra annectens*), and Mexican burrowing pythons (*Loxocemus bicolor*) (Werner and Rey, 1987; Peters, 1993). In captivity, predation mostly can be prevented by watching over the incubated eggs and by having the eggs incubated in a fenced area. Ants are the most prevalent predators of eggs in captivity.

Young

Van Devender (1982) observed that several species prey on iguanas (Table 1). The most important predator of juvenile green iguanas is the common basilisk, *Basiliscus basiliscus*. The adult basilisk feeds on hatchling iguanas. Iguanas are most susceptible to the basilisks in their first two to three months of age, but soon the iguanas become too large for most basilisks.

Table 1. Known predators of *Iguana iguana*.

Class	Species	Common name
Reptilia	*Basiliscus basiliscus**	Basilisk
	Ctenosaura similis	Black iguana
	Ameiva festiva	Middle American Ameiva
	Trimorphodon biscutatus	Lyre snake
Mammalia	*Homo sapiens**	Human
	Canis familiaris	Dog
	Philander opossum	Four-eyed opossum
	Didelphis marsupialis	Common opossum
Aves	*Quiscalus sp.*	Grackle
	Crotophaga major	Greater Ani
	Crotophaga sulcirostris	Groove-billed Ani
	Cassidix mexicanus	Great-tailed Grackle
	Piaya minuta	Little Cuckoo
	Piaya cayana	Squirrel Cuckoo

* Important predators (Van Devender, 1982; Werner and Rey, 1987)

In nature the mortality of young iguanas is high: three-fourths of the hatchlings disappears during their first four months of life. After the first four months, about half are lost each quarter for the first year. Only about 5% of the hatchlings survive after one year (Van Devender, 1982). The ability of hatchlings to escape predation is reduced by low body temperatures during the rainy season, the season in which they are born (Van Marken Lichtenbelt, 1991).

Adults

Predation losses of adult animals are small because of their large body size. Adults on islands, in particular, often have no natural enemies (Wiewandt, 1982). The most important predators of adult iguanas are humans (Table 1).

2.9 Diseases of green iguanas.

After predators, the survival rate of iguanas depends on the prevalence of diseases and the iguanas' resistance to these diseases. In nature, the role of diseases in mortality or in the weakening of the iguanas is unknown. In captivity, however, iguana diseases mostly are studied among iguanas held as pets, and zoonoses, such as salmonellosis, play an important role. On iguana farms, the following symptoms of diseases are seen: diarrhoea, loss of appetite and parasites on the skin. Most symptoms have unknown (unstudied) causes, and effective veterinary treatment is not available.

2.10 Products from iguana farming.

Iguana meat is still popular throughout much of Latin America. Consumers willingly pay more for iguana meat than for fish, poultry, pork or beef (National Research Council, 1991). Green iguanas are called 'chickens of the trees', because of their popularity and because their meat is comparable to that of chickens (Peters, 1993). Iguana meat typically is cooked in a stew (Fitch et al., 1982) and is said to stimulate the appetite of people convalescing from intestinal diseases.

In addition to iguana meat, the eggs of green iguanas are considered delicacies. The eggs are said to cure various ailments and to be an aphrodisiac. It is a widespread belief that one can remove the eggs from a female by surgery and the female iguana will survive. All females from which the eggs have been removed, however, will die from infection or from complications during the following reproduction period, because without oviducts they cannot lay their eggs (Peters, 1993; Werner and Rey, 1987).

The skin of iguanas is thin and fragile, but has a distinctive colour and pattern. To be able to use it, therefore, it is glued onto a fabric or cowhide backing to prevent it from tearing (National Resource Council, 1991). Skins can be used in the special leather market in, e.g. Masaya, Nicaragua, where they are sold as belts, purses, bags and shoes (Peters, 1993).

Juvenile green iguanas also are sold as pets. The young are exported from countries in Latin America to the USA, Japan and Europe (CITES, 1997). In Nicaragua, 80% of iguanas produced on-farm are exported. In Costa Rica export is restricted to a limited

number of farms with an export permit. In Panama, however, export of young iguanas is prohibited.

If iguanas are kept in tree lines or in patches of trees on farmland, these trees sustain the iguanas and produce fruits, timber and firewood for the farmers. Tree lines used for fences also help to prevent erosion from wind and water (Werner and Rey, 1987). Creating an iguana habitat on-farm, therefore, has a positive side effect: tree patches are maintained and/or planted. Iguana farmers and their neighbours also gain awareness about the need for conservation of natural habitats, which is where farmers obtain their parent animals. In addition to maintenance of trees on-farm and awareness of the conservation of natural habitats, the local population realises the negative effects of hunting green iguanas indiscriminately.

2.11 Introduction of iguana production systems.

In 1983, the Smithsonian Institute started reproducing iguanas in captivity in Panama (Werner and Rey, 1987; National Research Council, 1991). In 1985, iguanas were introduced on farms to be raised as an additional resource so as to provide income and to preserve the iguanas. There are three alternatives for using iguanas (National Research Council, 1991):

1. To manage wild stocks as game animals.
2. To breed young iguanas in captivity, and then release them into the wild where they can grow to full size and later be harvested on a sustainable basis.
3. To raise iguanas on farms, like chickens and pigs.

Iguanas grow slowly, and it takes about three years for them to reach market size for meat production. Raising them to maturity entirely in captivity is uneconomic (National Research Council, 1991). The third alternative to raise iguanas on-farm, therefore, is practised only for the production of pets or as a tourist attraction. Iguanas are raised on-farm for the production of pets, because juveniles are sold early at an age of three to five months; as tourist attraction, however, iguanas are required on-farm year-round. The third alternative is used also for special purposes such as for research or for breeding parent animals. It is possible, however, to raise iguanas in captivity until nine months of age and then release them in the forest or in trees planted on-farm, when the young have reached a size large enough to be invulnerable to most predators. Simple feeding stations keep the animals in the area and the iguanas can be harvested within two years. Raising young iguanas in captivity and then releasing them increases survival rate in nature after one year from 5% to 95% (Van Devender, 1982). This increase in survival rate results in a comparably accelerated rate of rebuilding the iguana population.

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Wiewandt, T.A., 1982. Evolution of nesting patterns in Iguanine lizards. In: G.M. Burghardt and A.S. Rand, eds. Iguanas of the world: their behaviour, ecology and conservation. Noyes Publications, Park Ridge, New Jersey, USA. pp. 119-141.

Preparing the earth was a hard job, and Sibö did not have the time to look after the basket with maize seeds. So Sibö thought, "I'm going to talk with the armadillo to ask if he will look after my basket"; and so it happened. The armadillo accepted the task without thinking. But Sibö said, "Look after my basket very well! Don't even think about touching it. I will be close!" The armadillo was happy; he just waited until Sibö went to his work.

Table 4. Experience of iguana farming and period having equipment available (months).

	No. of farms	Mean	Nicaragua	Costa Rica	Panama	*P*
Experience	31	62	35	29	91	0.001
Equipment	21	35	28	30	57	0.083

Table 5. Housing methods (number of farms).

Range	Housing method	Young iguanas	Adult iguanas
Highly artificial	1. Cage from chicken wire on posts	3	1
	2. Area with artificial shading, surrounded by metal plates	11	7
	3. Area with trees surrounded by metal plates	2	6
	4. As 3. with cultivated feed crops	1	2
Almost natural	5. Compound with trees and feed stations	0	7
	6. Forest edge (no fence)	0	1
Total		17	24

Technical aspects

The number of iguanas did not differ among countries or among types of farms. Current iguana farms had an average of 896 iguanas, of which about 80% were juveniles. The four former iguana farms were much bigger when they operated, having had an average of 2256 animals that were kept for sale. Current iguana farmers kept them for sale (46%), consumption (17%), 'not for use' (17%), tourist attraction (8%) and extension (4%; for courses, seminars, etc.). Motives for keeping iguanas differed among countries ($P = 0.004$): the proportion kept for sale was in Nicaragua 46%, in Costa Rica 33%, and in Panama 6%, for consumption in Panama 29%, and 'not for use' in Nicaragua 4% and in Panama 35%. The period for which farmers had produced iguanas or possessed equipment also differed among countries ($P = 0.001$ and $P = 0.083$, respectively), but not among types of farms (Table 4). Farmers in Panama had produced iguanas for an average of 7.6 years, in Nicaragua for 2.9 years and in Costa Rica for 2.4 years.

Housing facilities ranged from highly artificial to almost natural (Table 5). Those for young iguanas were more artificial, to protect them against predators and to make it easier to handle them. Housing methods for young did not differ among countries, but did for adults ($P = 0.013$). In Nicaragua, adults were kept in metal plate enclosures. In Costa Rica, adults were kept in similar areas or they were released after laying eggs. In Panama, most adults were kept in compounds (64% of the farms) or at forest edges without a fence (9%).

Reproduction is by two methods. In 'lay-and-carry' the female buries her eggs in a tray of washed river sand or in an open stretch of sand. When she has left the nest, the farmer digs up the eggs and puts them in sand in an incubator. In 'lay-and-stay', the

Table 6. Production parameters per country in 1997 as average per farm

Parameter	Total (n)[1]	Nicaragua (n)	Costa Rica (n)	Panama (n)
Eggs laid	728 (8)	434 (4)	1605 (2)	585 (2)
Eggs hatched	1356 (13)	1612 (9)	1013 (2)	550 (2)
Hatching (%)[2]	54 (8)	43 (4)	39 (2)	92 (2)
Iguana iguanas born	1356 (13)	1612 (9)	1013 (2)	550 (2)
Young *Iguana iguanas* died	130 (13)	127 (9)	260 (2)	15 (2)
Mortality young (%)	22 (13)	20 (9)	53 (2)	2 (2)
Adult *Iguana iguanas*[3]	154 (15)	163 (10)	195 (2)	98 (3)
Adult *Iguana iguanas* died[3]	20 (15)	24 (10)	13 (2)	10 (3)
Mortality adults (%)[3]	21 (15)	23 (10)	12 (2)	23 (3)

[1] Number of farms for which a specific parameter could be calculated

[2] Hatching % for the eight farms for which the number of eggs were known

[3] Over the total period the farm existed.

female lays her clutch in a self-dug hole in sand or in a gully, where the eggs stay during the incubation. The farmer tries to protect the nest from digging by other females. Numbers of non-hatched eggs left in the nest are recorded. The reproduction method did not differ among the countries, and 82% of farmers used 'lay-and-carry'.

Feed varied widely with season and local resources. Knowledge about the species that could be used also varied among regions, and the diet of young iguanas differed from that of adults. Iguanas were fed leaves, flowers, fruits, seeds, either leftovers from the market or collected from local trees. They included *Rivea corymbosa,* a climbing weed found in fences, beans, cabbage, Spanish plum, lettuce, *Cliricidia*, horseradish tree, and *Cordia spp.* Flowers from hibiscus and calabash trees were fed to young iguanas. Popular fruits included banana, mango, papaya, Spanish plum, squash and melon. Faeces from adult iguanas were fed to juveniles as a basis for their intestinal flora. Three farmers used seeds as feed; six supplied iguanas with medicines against parasites; five supplied vitamins and 18 fed concentrates. Different diets had to be prepared for young and adult iguanas. To improve the feed supply, farmers tried to cultivate crops such as maize and beans in the cages. Trees were also planted in the cages to provide shade and hiding places.

The production parameters varied considerably among farms. Therefore, the hatching rate and the mortalities of young and adult iguanas were calculated in an average of the rates per farm (Table 6). The number of eggs laid per farm varied from 30 to 2860 and was only known for eight farmers, who used the 'lay-and-carry' method or checked the number of eggs after hatching. In 1997, 13 farmers knew the number of young iguanas produced on their farm, with a mean of 1356. The hatching rate per farm varied from 7

to 96%, with a mean of 54% (Table 6). Reasons for non-hatched eggs, mentioned by 46% of the farmers, were incubation outside the permitted humidity (22% of these farmers) or temperature (11%), lack of knowledge about breeding techniques (22%), predators such as ants (22%), low fertility (22%), eggs laid outside the nest (11%) and human consumption of eggs (11%). The hatching rate was higher in Panama than in Costa Rica and Nicaragua.

Dead young iguanas were recorded on 76% of the reproducing farms, with a mortality of 22%. Reasons for these deaths included illness (58% of these farmers), squeezing to death (42%), predators (33%), escape (25%), and too much rain (17%). Dead adults were recorded on 63% of the farms, with a mortality of 21%. Reasons for these deaths included 'falling from a tree' (50% of these farmers), escape (29%), pregnant females not-laying eggs (21%), illness (21%), fighting (14%), stress due to captivity (14%), theft (7%) and predators (7%). The number of eggs laid and the mortality did not differ among countries. About 50% of farmers had disease problems with iguanas, the most commonly mentioned being parasites.

Conditions to produce iguanas mentioned by respondents

These conditions are summarised in Figure 3. Technical knowledge was considered more important by former iguana farmers (100% mentioned) than by neighbours (42%) or current iguana farmers (38%) ($P=0.064$). Official permission to catch or trade iguanas was considered more important by current farmers (26%) than by neighbours (0%) or former iguana farmers (0%) ($P=0.069$), probably because only current farmers knew that permission was needed. The use of wild animals for breeding was considered more important in Nicaragua and Costa Rica (both 67% of farmers) than in Panama (13%) ($P=0.038$).

Feed for iguanas was considered important by neighbours (79% mentioned) and iguana farmers (54%), but not by former iguana farmers (0%) ($P=0.01$). Water was considered important by current (21%) and former iguana farmers (25%) but not by neighbours (0%) ($P=0.094$). Money was considered more important by former iguana farmers (50%) than by neighbours (5%) or current farmers (13%) ($P=0.051$). The need for money was mentioned by 24% of farmers in Nicaragua, but none in Costa Rica or Panama ($P=0.049$). Availability of land was considered more important in Costa Rica (67%) than in Nicaragua (20%) or Panama (6%) ($P=0.008$).

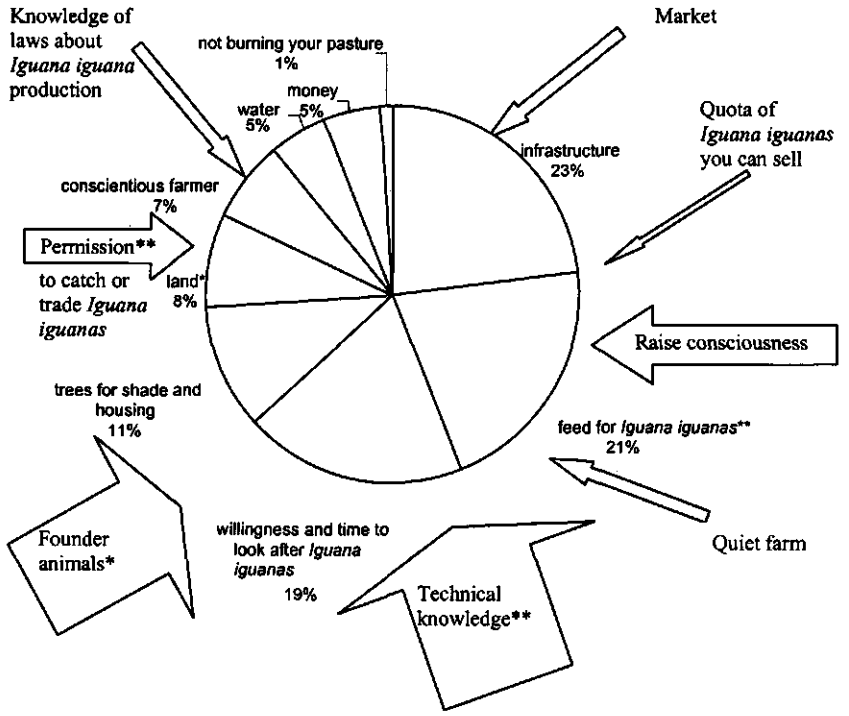

Figure 3. On-farm and off-farm conditions necessary to produce *Iguana iguanas*.

⇨ Off-farm conditions; the larger the arrow the more important the condition.

⊗ On-farm conditions

* different among countries

** different among farm types

Problems on iguana farms mentioned by respondents

On-farm problems were experienced by 61% of current and former iguana farmers. Technical problems (mentioned by 25% of the iguana farmers) included inadequate equipment and technical knowledge, causing bad hatchery management and disease. Economic problems (mentioned by 28%) included limited markets and finance. Ecological problems (mentioned by 28%) included predators, lack of founder animals in nature, deforestation, poor adaptation to captivity and poor availability of feed. Farmers had to leave the farm to search for feed, and iguanas foraged in agricultural plots and did not return. These problems did not differ among countries or types of farm.

According to 72% of neighbours and former iguana farmers, problems current farmers experienced were mostly social (45%) and technical (30%). The former included theft of iguanas and the need to care properly for them. The problems experienced differed among countries ($P = 0.003$). In Panama, 78% of the problems were social, whereas in

Nicaragua 71% were technical.

3.4 Discussion and Conclusions

The small number of respondents for each type of farm and the variability in responses make it difficult to establish statistically significant differences, but the differences might point to important conditions for successful iguana farming. Social aspects are important. Most household members of former iguana farmers earned their living off-farm, and a major reason why they discontinued iguana farming was because it was time-consuming and conflicted with the off-farm jobs. Pérez et al. (1993) claimed that opportunity costs for labour could be ignored, because of the lack of alternative employment, and the National Research Council (1991) contented that "for smallholders the only cost of raising iguanas is labour, and that is often unimportant". However, our farmers found it difficult to take care of young iguanas during the wet season, when priority is given to food crops. Co-operative farms were found mainly among current and former iguana farms; being a co-operative farm increases access to technical knowledge, training facilities and credit, thus facilitating the introduction of iguana farming. Iguanas are reared mainly by men, while partners and children contribute to the day-to-day work. The introduction of iguanas reduces the responsibility of women for the animals on the farmyard, but increases their workload. Fitch et al. (1982) and Werner (1991) claim that iguanas are a traditional rural food and thus culturally accepted, but they did not take into account that this is not the same as being accepted for farming.

Most iguana farmers received special training. Not only did they consider this necessary, but the courses could usefully cover subjects such as construction of cages, management of eggs and young stock, prevention of diseases and administration. Technical aspects and the motives for production differed among countries. Commercial motives ('for sale') prevailed in Nicaragua and Costa Rica, where most adult iguanas were housed in an area surrounded with metal plates. In Nicaragua, 43% of neighbours mentioned that iguana farmers faced problems with their equipment such as corroding plates and rotting posts. Non-commercial motives ('not for use' and 'consumption') were found in Panama, housing was usually more natural, on a compound or at forest edges. In Panama and Costa Rica, neighbours reported no problems with equipment. The more natural the housing facilities the better was their hatching rate. Experience in iguana farming also affected hatching. In Panama, where iguana farmers had longer experience than those in the other countries, the hatching rate (85%) and mortality of the young (11%) were comparable to reported values (Werner, 1991; National Research Council, 1991; Peters, 1993), and better than in Nicaragua and Costa Rica.

The on- and off-farm conditions mentioned by the respondents corresponded with the

major factors that should be considered when introducing a new species (Owen, 1981; Schlolaut, 1985; Lebas et al., 1986; National Research Council, 1991; Udo, 1997). Whether the respondents had experiences with iguanas was reflected in the frequency of conditions mentioned. Former iguana farmers mentioned mostly 'technical knowledge' and 'money', and only current iguana farmers mentioned 'permissions needed to trade iguanas.' There were differences among countries in the incidence of 'founder animals' (mentioned mostly in Nicaragua and Costa Rica), 'money' (in Nicaragua) and 'land' (in Costa Rica). These conditions were probably more difficult to be met in these countries than in Panama. For example, the number of wild iguana was decreasing rapidly in Nicaragua and Costa Rica, so founder animals were becoming a limiting condition.

Current and former iguana farmers, and neighbours, differed about the problems of iguana farming. Current farmers mentioned mainly technical, economic, and ecological problems, while the others mentioned mainly social and technical problems. Neighbours mentioned mostly social problems in Panama and technical problems in Nicaragua. It could be that in Panama most technical problems had been solved, because of the long experience in iguana farming.

The overall conclusion is that social and technical aspects at the farm level influence the prospects for iguana farming and farmers can influence these aspects only marginally. Some farmers keep iguanas for consumption rather than for sale, which would avoid the problem that market prices are too low to cover the costs of production (Chapter 4). Farmers can release adult iguanas in their compound and then it will not be necessary to collect feed; it can also improve the hatching rate. This can relieve the problem of equipment, a constraint arising from the shortage of capital.

3.5 Acknowledgements

We thank all the farmers and respondents who helped in this survey; the individuals and international and national groups who co-operated, and provided information; the Netherlands Organisation for Scientific Research for help with travelling expenses and Mike Grossman and Fokje Steenstra for help with this article.

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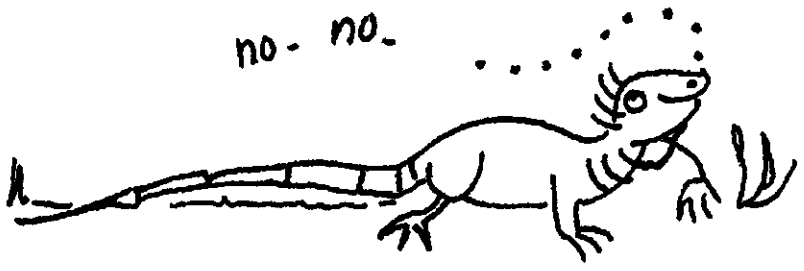

After a day of hard work, while everybody in the field was satisfied with the job done, Sibö smelled a scent of toasted maize. He approached the iguana and asked, "Do you smell this odour?" The iguana smelled and answered, "No!"

Chapter 4

Analysis of *Iguana iguana* farming systems in Nicaragua, Costa Rica and Panama.
Economic, ecological and legislative aspects

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Submitted to ***Interciencia.***

Abstract

This survey aimed to evaluate existing *Iguana iguana* (Green iguana) farming systems in Nicaragua, Costa Rica and Panama. Data were gathered in 1997, by interviewing iguana farmers, their neighbours, iguana experts and government officials about the purported socio-economic and ecological benefits of iguana farming. It was expected that iguana farming provides additional revenue, stimulates nature conservation, produces animal protein, increases the number of trees and augments the knowledge about nature. A major constraint is the initial investment, especially if banks provide no credit programmes and if smallholders depend on the credit schemes of Non-Governmental Organisations (NGOs). In Nicaragua and Panama, the existing iguana farming systems have poor prospects to generating additional revenue. Iguana farming has ecological benefits: a positive nature conservation attitude is found among iguana farmers, conservation of trees, the knowledge of farmers about nature is augmented and local feed resources are used. Existing legislation and regulations on Iguana farming and trade (including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)) limit the possibilities of commercialising iguanas and their products. Most iguana farming systems were not generating extra income, had high initial costs, needed professional help to meet the statutory requirements but did change nature conservation attitude, used local feed, and augmented the farmers knowledge about nature. To introduce iguana farming successfully, it must be profitable for the farmers and they must be given professional help to meet the statutory requirements for iguana farming.

Keywords: Green Iguana, *Iguana iguana*, Nicaragua, Costa Rica, Panama, Farming systems.

4.1 Introduction

Farmers in Central America have limited possibilities to use agricultural production techniques, such as slash and burn techniques to grow basic food crops, because suitable land needed to move on is occupied. These production techniques are associated with continuous deforestation and soil erosion (Gradwohl and Greenberg, 1988; Buffa and Werner, 1989; Pérez, 1994; Kaimowitz, 1995). During the dry season, when their plots are fallow, farmers exploit the surrounding natural forests to support their family, e.g. hunting wild animals, collecting firewood, extracting timber, wood and thatch to repair their huts (Gutierrez, 1996). This leads to forest degradation. Under the current economic conditions, these unsustainable practices constitute virtually the only option for the resource-poor farmer to make a living. In an effort to stop the process of forest degradation, non-governmental organisations and government institutes in Central America have proposed *Iguana iguana* (Green Iguana) farming as an alternative. The benefits were thought to be: providing extra income for smallholder farmers, stimulating the nature conservation attitude of the rural population, producing animal protein, increasing the number of trees and augmenting the farmers' knowledge about nature (Pérez et al., 1993a; Madrigal and Solís, 1994; Ruiz Rodríguez and Ascher, 1996). Both an ecological niche and a niche in the market are required. To be attractive to smallholders, the iguana farming system should have low initial costs, use locally available feed and be labour extensive.

Iguana and its possible exploitation

Iguana farming can only be introduced in their natural habitat, ranging from south Mexico to Brazil and some Caribbean islands at an altitude below 1000 m. Here the animals are indigenous and can reproduce. Iguanas are reptiles and live in forest borders. They especially prefer river margins as habitat. Burghardt and Rand (1982) describe biological information about the green iguana. They can adapt to life in trees on a compound or in tree lines, such as used for erosion prevention or as a fence. It is possible to breed iguanas in captivity with a survival rate of 80 to 95% (Werner, 1991), compared to 5% in a natural situation (Van Devender, 1982). To maintain the habitat of the founder animals and to create a habitat on the farm, trees have to be planted, or should not be cut. To maintain the habitat for founder animals it is especially important to protect the trees near rivers and forest edges, so that streams, wells and forests are also protected (National Research Council, 1991).

By keeping iguanas in trees, it is thought that a profit can be made, while the trees are growing (National Research Council, 1991). Iguanas eat tree leaves and fruits, and thus can survive and produce without expensive inputs such as concentrates. The local population in Central America eats iguanas and their eggs (National Research Council,

1991), and uses their hides to produce special leather for the tourist industry. More recently, a market has developed for young iguanas as pets.

Existing laws and regulations on iguana farming and trade stipulate what a farmer must do to obtain permission to farm and trade iguanas. Nicaragua, Costa Rica and Panama are among the 146 countries that have ratified the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), founded in 1973, and have to implement it in their national legislation. *Iguana iguana* is on Appendix II of CITES and regulated trade is possible.

The present study is a critical evaluation of existing iguana farming systems in Nicaragua, Costa Rica and Panama. This study aims to assess to what extent the existing iguana farming systems had met the benefits and conditions, emphasising the economic, ecological and legislative aspects of the farming system.

4.2 Materials and Methods

The research area

Current iguana farming was evaluated for Nicaragua, Costa Rica and Panama. Nicaragua is a large, sparsely populated country (Table 1). Gross National Product (GNP) of Nicaragua is low, i.e. 50% of its population lives below the national poverty line. Most people live in the west of the country that has a tropical savannah climate with a wet and a dry season. It is here that most iguana farms are located. Temperature varies between 18 and 31°C. Mean annual precipitation varies between 1000 and 2000 mm (Huysegems, 1998).

Table 1. Some key statistics for Nicaragua, Costa Rica and Panama in 1996

	Nicaragua	Costa Rica	Panama
Land area (km^2)[a]	121 400	51 060	74 430
Arable land (km^2)[a]	24 570	2 850	5 000
Permanent crops (km^2)[a]	2 890	2 450	1 550
Number of people per km^2 [a]	36	70	37
Gross National Product '97 (US $ per capita)[b]	410	2 640	3 080
Total population (million)[a]	4.35	3.57	2.72
Economically active (million)[a]	1.7	1.4	1.1
Economically active in agriculture (million)[a]	0.38	0.31	0.24

[a] FAO 1997

[b] World bank data: mean GNP for Latin America and the Caribbean is 3880 US$

Costa Rica is the most densely populated country of the three (Table 1). GNP of Costa Rica is below the mean for Latin America and the Caribbean (US$3880). Most people live in the Central Valley around San José. Iguana farms are located in the western part

of Nicoya peninsula, in the province of Guanacaste (Northwest), in the southeast, in the province of Limon and in the central-west, in the province of Alajuela. Nicoya peninsula and Alajuela have a tropical savannah climate with a wet and a dry season, Limon has a tropical rainforest climate with rain year-round. Mean annual temperature is 30°C in Limon, 33°C in Alajuela and Nicoya. Mean annual precipitation varies between 2000 (Nicoya peninsula) and 3000 mm (Southeast of Limon) (Daling, 1996).

In Panama, GNP is the highest of the three countries and approaches the mean for Latin America and the Caribbean (Table 1). Most people live in Colon, a city at north end of the Canal, or Panama City, at south end, or in the pacific part of Western Panama between Costa Rica and the Canal. There are iguana farms in the provinces of Herrera, Cocle and Panama, the Central Provinces, on the islands of Bocas del Toro and in the province of Darien. Herrera and Cocle have a tropical savannah climate with a wet and a dry season, Panama, Bocas del Toro and Darien have a tropical rainforest climate with rain year-round. Mean annual temperature varies between 23 and 28°C in Herrera and Cocle and between 25 and 28°C in Panama, Bocas del Toro and Darien. Mean annual precipitation varies between 1500 and 2500 mm (Mark, 1974).

Data collection

As the household is the basic hierarchical level of the community in which the iguana farming system functions, information on iguana farming was collected from 49 households: 26 in Nicaragua, six in Costa Rica and 17 in Panama. The sample comprised 24 iguana farms, 21 neighbour households and 4 former iguana farms, i.e. farms that had recently stopped iguana farming (Table 2).

Respondents (the head of the household) were interviewed with a questionnaire consisting of 62 open-ended questions on economic and ecological aspects (Annex 1). Economic aspects included land, initial investment, market and labour requirements. Land is related to the total area available, land use and land used for iguana farming. Initial investment is related to the capital needed to start a farming system, to buy founder animals and materials to construct the cages. Market is related to the opinion of the respondent on the future for iguana farming, the number of iguana farms in the future, the demand for iguana products on the local market, the consumption of iguana products, the number of iguanas and of eggs sold. Labour requirements are related to the daily chores of iguana farming and tending young iguanas. Ecological aspects included nature conservation attitude, local resources like feed and trees, knowledge about nature and disturbance by predators. Nature conservation attitude is related to the opinion on endangered animals, the number of trees planted and the ranking of nature conservation objectives on the farm. Local resources are related to iguana feeds and trees available on the farm. Knowledge about nature is related to knowledge about

iguanas and courses followed about iguana and agricultural production. Answers on questions about knowledge about iguanas were coded as 'good' or 'sufficient' depending on their correctness and completeness. Predators were related to predator incidence and type of predators.

Table 2. Number of respondents interviewed by country and farm type.

Country	Iguana farm	Neighbour	Former iguana farm	Total	Total number of iguana farms existing in 1997
Nicaragua	11	12	3	26	32
Costa Rica	2	3	1	6	5
Panama	11	6	0	17	18
Total	24	21	4	49	55

In addition, eight iguana farming experts from non-governmental organisations (NGOs) promoting iguana farming on smallholder farms were asked in a semi-structured interview about their goals and prospects of promoting iguana farming. The NGOs stimulate iguana farming by giving courses, providing farmers with founder animals and giving them credit for cages and feed.

Data on the habitat of iguanas, on laws and rules with respect to iguana farming in each country and on the market possibilities were collected from the literature and by interviewing the iguana farming experts and four officials of the government bodies responsible for legislation on and control of iguana farming.

Data analysis

The STATISTIX statistical program (STATISTIX Analytical Software, 1992) was used to analyse the data. For data recorded as frequencies we applied the Chi-square test to test dependency of row and column factors. An F-test was used on measured data, to test differences between means. The analyses are indicative, as in many cases the basic assumptions for an exact statistical analysis were not met.

4.3 Results

Iguana farming system

Table 3 presents the characteristics of the farms per country. Forty-three percent of the respondents could be considered as resource-poor farmers, with 10 or fewer hectares and 3 or less number of cattle, while 46% of the iguana farmers consisted of resource-poor farmers. In Nicaragua and Costa Rica the farmland was mainly used for basic food crop production (e.g. maize (*Zea mays* sp.) and beans (*Cajanus cajan*)). On the Nicaraguan farms there was not enough space to separate the iguanas from the agricultural plots, and the iguanas were kept in cages, as some food crops are a favourite feed (National Research Council, 1991; Werner et al., 1993). On average the

farms in Nicaragua were smallest (13.9 ha), had the largest cages (area of 510 m^2) and a high number of iguanas (1468).

Table 3. Resource-poor farms, average farm size, land use, livestock numbers per farm and land needed to farm iguanas, per country

	N[a]	Mean	Nicaragua	Costa Rica	Panama	P
Number of farms with ≤ 10 ha and ≤ 3 number of cattle						
Resource-poor farms	21		13	3	5	0.38
Iguana farms	11		7	1	3	0.23
Farm size (ha)[b]	49	29.5	13.9	37.8	50.3	0.02
Land use (% of total available land per farm)[c]						
Pasture [b]	28	49	36	26	75	0.001
Trees	40	33	32	47	30	0.52
Crops	42	34	44	37	22	0.07
Fruit trees	36	14	15	30	8	0.24
Livestock numbers per farm						
Iguanas	33	1433	1468	1535	269	0.06
Cattle	29	26	11	11	59	0.11
Horses[b]	28	3	3	4	5	0.05
Pigs	19	3	4	4	2	0.16
Poultry	40	19	16	23	23	0.27
Land for iguana cages						
Cages in m^2 [d]	17	405	510	66	285	0.38

[a] N: number of farms included in the analysis

[b] Significantly different at 5% level among countries

[c] Total can not be added to 100, because different components are based on different number of farms

[d] Estimated

Table 4. Percentage of iguana farmers using specific feed for iguanas and mean number of species used per category

Feed / Supplements	% of farmers[a]	Mean number of species used
Local feeds	**94**	
Leaves	94.1	4.4
Fruits	88.2	3.9
Flowers	70.6	2.8
Off-farm feeds	**88**	
Concentrates	70.6	1.5
Seed	23.5	1.3
Market residues	41.2	-
Medicines	35.3	-
Vitamins	29.4	-

[a] N = 17 farmers

Economic aspects

Available land for feeding iguanas

The area of farmland needed for feeding iguanas depends on the number of animals to be fed and on the on-farm and off-farm feed resources used. Feed resources, which require land, are fresh leaves, fruits, flowers and seeds. Most iguana farmers (94%) used these feed resources from the farm and from roadsides to feed their iguanas (Table 4).

Table 5. Total initial costs (US$) to start an iguana farm and annual feed costs per farm per country

	N[a]	Mean	Nicaragua	Costa Rica	Panama	P
Initial costs						
Materials	16	1944	976	2026	4323	0.17
Other supplies	14	19	10	0	55	0.31
Founder population[b]	16	280	444	18	0.0	0.046
Total initial costs		2243	1430	2044	4378	
Feed per year	8	81	92	179	6.5	0.66

[a] N = number of farms included in the analysis

[b] Significantly different among countries at 5% level

Initial investment

A farmer wishing to start iguana farming must buy founder animals and the materials for building cages (Table 5). The costs for materials include costs of cages, drinking and feeding troughs, nests, incubators, a net to cover the cage and water supply. The cages were the most expensive items. Prices varied greatly among farms: US$42 - US$3000 per cage, depending on size and materials used. Other equipment purchased included thermometer, hypodermic syringe, ant poison, diesel, wire, scales, camping gas, plastic bags, canvas bags, water pump and extended scissors. The Costa Rican respondents did not mention the equipment.

To obtain a founder population some farmers had captured iguanas from the forest. However, most iguana farmers had to buy in wild iguanas twice, because of the shortage of supply. On average, farmers bought in 166 iguanas, with an average age of 39 months. The price of a founder animal differed significantly among countries ($p = 0.003$: Table 6). In Nicaragua a founder animal cost on average US$3.54, in Costa Rica US$0.22 and in Panama they could be caught in the natural forest after obtaining a permit (US$5). The average price for a founder animal was US$1.70 and the highest price paid was US$8.24. The difference in obtaining founder animals among countries causes a significant difference in the investment in the founder population among these countries (Table 5). Eight farmers mentioned that in addition to the initial investment, they spent on average US$81 a year on concentrates. The mean total initial costs of US$2243 were the sum of the costs for materials, other supplies and founder animals.

Only six of the 49 respondents considered capital an important precondition to start an iguana farm, probably because of the credit programmes available. In Nicaragua, the Food and Agricultural Organisation (FAO) had a programme that supplied farmers with the initial sum to buy founder animals and materials for the cages. FAO in Costa Rica had a similar programme, but instead of supplying credit to buy founder animals, they added an annual loan to buy concentrates. All organisations supplied the farmer with at least part of the initial investment. Only three farmers with above average income (earned as teacher, agricultural official and from on-farm wood production) were able to finance the farming system with their own capital.

Table 6. Characteristics of iguana marketing and operation time per farm per country up to 1997

	N [a]	Mean	Nicaragua	Costa Rica	Panama	P
Operation time of farm (months)[b]	16	42	29	9	88	0.01
Sales of iguanas						
Number of sales	11	2.5	1.9	3.5	3.5	0.39
Total number of iguana sold	11	1305	1788	281	638	0.54
Total income from iguanas (US$)	11	2012	1192	2615	722	0.67
Price per iguana in 1997 (US$)						
Adult iguanas [b]	9	6.25	3.84	21.25	6.0	0.00
Replacement animals	4	4.40	3.19	-	8.0	0.17
Young iguanas [b]	11	1.96	1.70	4.25	1.86	0.01
Sales of iguana eggs						
Number of sales	2	1	-	1	1	. [c]
Total number of eggs sold	2	75	-	120	30	. [c]
Total income from eggs (US$)	2	0.43	-	0.85	0.0	. [c]

[a] N = number of farms included in the analysis

[b] Significantly different among countries at 5% level

[c] Not enough degrees of freedom to calculate P

Market

In Table 6 the characteristics of iguana marketing are shown. Of the iguana farms 65% had sold animals, 12% had given away young iguanas and 23% had done neither. Young iguanas were sold, mostly as pets, by 53% of the farmers. Adult iguanas were sold to consumers for their meat and hides or given to other iguana farms by 6% of the farmers, and 6% sold both young and adult iguanas. Twelve percent of the farmers sold iguana eggs or gave them away. In Nicaragua, most farmers had only sold iguanas twice, probably because it is mandatory to sell in the presence of a government official, while in Costa Rica and Panama iguanas are sold without a government official. In Costa Rica and Panama the number of sales was higher, but note that the Panamanian farms had been operating for longer. The total number of iguanas sold was higher in Nicaragua than in Costa Rica and Panama (Table 6). Average total income from iguana sales was US$2012; this did not differ significantly among countries.

The actual or estimated prices in 1997 for adult iguanas were significantly higher in Costa Rica than in Nicaragua and Panama (Table 6). According to the respondents the price fetched by an iguana depends on its length (mentioned by 10 farmers), its age (nine farmers) and its weight (mentioned once). The factors mentioned as affecting positively the price of female iguanas were the increasing number of times they had laid eggs and if they were pregnant.

Only 25% of the farmers had higher total revenue from the sale of iguanas since the start of their farm than their initial investment. These farmers had an operational period of 59 months on average, while the other 75% of farmers had an operational period of 39 months ($p=0.14$).

The iguana farmers not only sold iguanas as pets and founder animals, but also for consumption. Eighty-two percent of the respondents reported eating iguanas and 65% eating iguana eggs. There was no difference among countries in iguana meat consumption by respondents, or in the frequency of this consumption. However, iguana eggs were eaten more often in Nicaragua (37% once a year, 26% 3 to 6 times a year and 37% 9 times a year), than in Costa Rica (one person once a year and one person 3 to 6 times a year) and Panama (100% once a year). The reasons given for eating iguana eggs were "nice taste", "found a female with eggs", "healthy food", "found broken eggs in nest" and "it is customary". The reasons given for eating iguana meat were "nice taste", "healthy food", "we were poor", "abundantly available", "to get rid of an old/sick animal", "restores the appetite after illness", "rich in protein" and "living far from village where you can buy other meat". Most respondents indicated that they were used to eating iguanas, but did not eat them as frequently as before, or had stopped eating them. They felt that most arguments in favour of eating iguanas or their eggs were still valid, except that numbers in nature had decreased. No difference in motivation was found among countries.

The iguana farmers were asked their opinion on the future price for iguana products: pets, meat, hides and eggs. The reasons they expected the price for iguana products to rise were: favourable international market (five respondents), increasing tourism (once), almost no iguanas left in the wild (once), and the favourable local market (once). The reason given for an expected decrease in price was too many iguanas bred in captivity. If the price trends for all iguana products are considered, the negative and positive opinions on the expected trends counterbalance.

With respect to the future of iguana farming in general, 76% of the respondents thought that the demand for iguana products on the local market would increase and 70% that the number of iguana farms would increase. The iguana farmers were less optimistic

about the future of iguana farming than the other respondents. One condition mentioned several times as a prerequisite for an increase in number of iguana farms was market development, governing the possibility to earn an income.

Of 21 respondents who were "neighbours" and eight who were fattening iguanas, 66% said they wanted to breed iguanas in the future, 10% said they only want to breed iguanas if a good market exists, so they can earn an income, and 24% said they will not do. Motives for wanting iguanas were to earn an income and to protect them, to eat them, for exhibition and to conserve natural resources. These motives corresponded with the benefits from iguana farming systems foreseen by the NGOs. Reasons mentioned for not keeping iguanas were the required labour (the volume) or the age of the respondents (too old to start a new project).

Table 7. Use of trees on-farm and mean number of species per objective

Use of trees	% of respondents [a]	Mean number of species
Timber	76	4.3
Fruit	59	4.4
Firewood	37	3.0
Sun/wind protection	33	3.2
Fence	24	2.5
Iguana feed	22	2.7
Cattle feed	16	2.3
Medicine	6	1
Reforestation	2	11
Rubber	2	1
Increase soil fertility	2	1
No specific use	8	-

[a] N = 49

Labour requirements

Tending young iguanas was concentrated from May to September. These activities required 4.5 weeks of labour in the wet season, when there are many activities with other crops (Gutierrez, 1996) causing a conflict in labour requirements. Daily chores, such as cleaning cages, feeding and protecting the iguanas, required from 15 min to 10 hours a day (mean 3.5 hours), depending on whether the animals were fed on-farm resources and on whether they were protected round the clock or only during daylight.

Ecological aspects

Trees

In total, the respondents mentioned 108 different tree species and each species served at least one purpose. Production of timber and fruit were the most common purposes, representing the largest number of tree species, except for the 11 species mentioned for reforestation to simulate a natural forest (Table 7).

Ninety-two percent of all respondents had planted trees on their farm, with a mean of seven different species (ranging from one to 19). There was no difference in tree planting among iguana farmers, neighbours and former iguana farmers, indicating that tree planting has not been stimulated more among iguana farmers. However, former and present iguana farmers had a far larger part of their farm planted with trees (64% and 38% of the area, respectively) than neighbours (9%).

Locally available feed

Locally available feed, such as fresh leaves, fruits and seeds means low feed costs and is used by 94% of the iguana farmers. Furthermore, 88% of the iguana farmers added off-farm feed resources and supplements, such as concentrates, medicines and market residues, with average costs of US$81 per year (Table 4 and 5). Iguana farmers, who did not feed concentrates (the most expensive off-farm feed) kept only 156 iguanas on average (range 12 - 410), i.e. far fewer than the overall mean of 1433 (Table 3). Most farmers feeding concentrates to their iguanas did this to complement the diet. The diet of iguanas consisted largely of fresh feed, however with an increasing number of iguanas most farmers shifted to using more off-farm feed, such as market residues.

The leaves included *Ipomoea* sp., a climbing weed found in fences, beans (*Cajanus cajan*), cabbage (*Brassica oleracea*), Spanish plum (*Spondias purpurea*), lettuce (*Lactuca sativa*), *Gliricidia*, horseradish tree (*Spondias mombin*), and *Cordia* sp. Flowers from hibiscus (*Hibiscus* sp.) and *Ficus* sp. were fed to young iguanas. Popular fruits included banana (*Musa* sp.), mango (*Mangifera indica*), papaya (*Carica papaya*), Spanish plum, squash (*Cucurbita* sp.) and melon (*Cucumis sativus*).

Nature conservation attitude

Respondents were asked for their reaction to the word "iguana". This differed significantly among countries ($p=0.006$), but not among farm types. For 35% of the respondents, the word "iguana" brought nature conservation to mind ("protection of an endangered species" and "part of nature"). In Panama, 65% of the respondents mentioned nature conservation, in Costa Rica 50% and in Nicaragua 12%.

Respondents were asked to name the objectives of their farm and list them in order of importance (1 is the most important). Nature conservation objectives were protection of animal species, protection of the forest against slashing, stimulating wood production and protection of habitat, nature and earth. Iguana farmers mentioned a high percentage of nature conservation objectives (24% of the objectives) and ranked them the lowest (2.5), which shows the importance they attached to these objectives. Iguana farmers practised conservation on their own farm. Neighbours were aware of the need for nature conservation (9% of the objectives), but did not consider it that important

(ranking of 3.7). They found nature conservation less important than other objectives, such as self-sufficiency, earning an income, and milk or meat production.

Knowledge about nature is related with nature conservation attitude: respondents consider nature conservation important, because they know about it. Knowledge about nature was measured with the respondents' knowledge about iguanas and if they obtained this knowledge by following courses. Knowledge about iguanas differed among types of farms ($p = 0.03$), but not among countries. Predictably, present iguana farmers gave significantly more "good" answers about birth (50%) and habitat of iguanas (25%) than neighbours (33% answered good about birth and 0% about habitat) and former iguana farmers (0% about birth and 0% about habitat) (Eilers et al., 2001). The level of agricultural education of the respondents differed among types of farms ($p = 0.034$), but not among countries. Neighbours were educated less in agriculture (43%), compared to present (96%) and former iguana farmers (75%). Iguana farmers participated in more courses (3.4) than their neighbours (1.8) or former iguana farmers (2.3) ($p = 0.037$).

The number of days respondents participated in iguana courses differed among types of farms ($p = 0.016$), but not among countries. Iguana farmers took 17.8 days of iguana courses, neighbours 5.0 days, and former iguana farmers 2.7 days. Benefits of taking an iguana course included acquiring basic knowledge to keep iguanas (50%), preventing extinction (17%), acquiring general knowledge (13%), learning about iguana feed and about incubation of eggs (8%), and improving the standard of living of their family (12%).

Predators

Predators form part of the natural environment in which iguana farms operate. They control the natural population of iguanas and are attracted to large groups of young iguanas. Some of the interviewed farmers had learnt how to deter predators without harming them. One farmer said: "Predators have the right to live" and another farmer said: "They not only kill young iguanas, but also the rats and mice that attack our crops. So they keep nature in balance".

The iguana farmers mentioned the following predators (given in decreasing order of importance): birds, snakes, cats, foxes, people, green iguanas (adults) and *Iguana Ctenosauras* (black iguana), ants, rats and dogs. Predators entered 47% of the iguana farms once or twice a year, 12% of the farms three to six times a year, one farm once a month and one once a week. No difference was found in predator incidence among countries. Predator attacks caused death of adult iguanas according to one farmer, death

of young iguanas according to three and non-hatching of eggs according to two. Seventy-six percent of the iguana farmers said they had problems with predators.

The methods used to deter predators were: sleeping next to the iguanas (67%), covering cage with net (42%), killing predators (17%), using garlic to deter snakes (8%) and chlorine to kill ants (8%). Of these, sleeping next to the iguanas and killing predators were very time-consuming.

Legislative aspects

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which regulates the trade in wildlife species, consists of three Appendices of endangered species of plants and animals and 25 articles describing the regulations applying to these species. The *Iguana iguana* is included in Appendix II, which includes all species that although not necessarily threatened with extinction may become so, unless trade is strictly regulated to avoid use incompatible with their survival (CITES, 1973). In all three countries, CITES was implemented in the national legislation.

Every year, in all three countries a fixed percentage of the initial founder stock obtained from the forest has to be returned via the management authority. In Panama, e.g. 10% of the founder population (INRENARE, 1990) and 5% of the animals raised (INRENARE, 1990) has to be returned to their natural environment, to maintain the population.

Each year the scientific authority of an exporting state determines a quota, the maximum number of iguanas the state can export. E.g. the quota for Costa Rica in 1997 was 85,000 live wild iguanas (CITES, 1997). In Nicaragua there are 21 farmers/traders with permission to export iguanas; in Costa Rica there is only one such farm. In Panama 3 farms have applied for permission to commercialise iguanas nationally. For all three countries CITES provides the framework within which the countries can decide what conditions have to be fulfilled before export of iguanas is allowed. Farmers have to acquire several permits and certificates before they may start to look for founder animals. Poorly educated farmers are at a disadvantage, because the procedure requires a written project proposal. This requires knowledge about natural resources and the ability to write. All farmers have to consult a professional in natural resources to formulate their project proposal.

4.4 Discussion

In Nicaragua 34% of the iguana farms have been surveyed, in Costa Rica 40%, and in Panama 61% (Table 2). In Nicaragua, all small iguana farmers (n = 12), except one, were interviewed; the other farmers are commercial iguana exporters, who by law were obliged to breed iguanas. In Costa Rica, two smallholders were interviewed and the

objectives of the other farms were research and education. In Panama, 11 of the 18 farms were visited. Of all respondents 43% and of the iguana farmers 47% could be considered as resource-poor farmers. Iguana farming was not restricted to resource-poor farmers, but all farmers that showed interest could start farming iguanas.

In 1997, Nicaragua exported 15,230 iguanas, Costa Rica 11,481 and Panama 0 (World Conservation Monitoring Centre, 1999). The number of sold animals in Table 5 is small compared to the exported animals recorded by CITES, because our sample takes not into account the production from commercial iguana exporters.

Economic aspects of iguana farming

The expected economic benefits of iguana farming are low feed costs by using locally available feed on available land, low initial costs, providing extra income, producing animal proteins, and requiring a small amount of labour.

Available land and low feed costs

On smallholder farms iguanas can be kept free ranging in tree lines and thus be combined with cattle production, arable farming (trees used as fences) and wood production. On one hectare of adequate tree species 100 iguanas can be kept without complementary feed (Pérez et al., 1993a). However, a border area of 20 to 50 meters between the trees and the crops is needed to keep iguanas away from the agricultural plots (Werner et al., 1993). The land needed for iguana farming consists of an area for cages and for growing feed or an area for free ranging. Iguanas, kept in cages, were fed with feed grown on the farm or collected from roadsides. At present, the available land is not a constraint for the production of iguanas. With several iguana farms in the neighbourhood, there can be competition for feed from roadsides and more will have to be grown on the farm, thus demanding more land. If a farmer keeps more than approximately 400 iguanas it is difficult to meet their feed requirements with on-farm and roadside feed resources, because of the labour required and because the supply of fresh leaves, fruits and flowers is insufficient. Consequently, on farms with a large number of iguanas the animals have to be fed with commercial feed. In this survey most farmers added concentrates to the diet of locally available feed, increasing feed costs with an average of US$81 per year. The iguana farmers considered the feed costs high and in some regions the feed was difficult to obtain.

Low initial costs

A precondition for the adoption of iguana farming by resource-poor farmers is low initial costs of the farming system. Due to expensive materials and the expensive founder animals (especially in Nicaragua) the initial costs were high, and thus for resource-poor farmers difficult to obtain without credit facilities. The most expensive

items were the cages that differed greatly in price among farms. With the construction of the cages there are still possibilities to save money, e.g. using local materials or simplifying the design of the cage.

The price of founder animals was much higher in Nicaragua than in Costa Rica and Panama caused by sharply falling numbers of wild iguanas and because middlemen drive up prices. Wild iguana numbers are falling because the animals are being poached for food during the dry season and are being smuggled to El Salvador and Honduras for sale on the national or international market (Fitch et al., 1982; Gutierrez, 1996). According to iguana farming experts, the price of an adult animal produced on a farm was low in Nicaragua, because middlemen kept the prices of produced adult animals low. By reselling them as founder animals to other farms the prices were highly increased.

The difference in price between a founder animal and a produced adult animal was large in Costa Rica and Panama. A possible reason for the low price for founder animals in Costa Rica was that founder animals were available near the farm and only a "catch wage" had to be paid. The high price for animals produced on a farm was possibly caused by the fact that only a few farms in Costa Rica had permits to market iguanas. In Panama, founder animals were almost for free, because they can be caught in the wild (with permission).

Providing extra income

Income from iguana farming depends on the cost and retail prices, the future price trends and the initial investment. At this moment cost and retail prices of young iguanas are very important, because 59% of the iguana farmers is selling young iguanas. The cost price is calculated with costs for materials and feed, and with opportunity costs for land and labour. The opportunity costs for land can be ignored when iguanas are released on a compound or on a tree plantation, although then the reduced production of the trees has to be calculated as an extra cost (Sandlund et al., 1993). Respondents indicated that opportunity costs for labour should be taken into account, due to competition between labour needed for iguana farming and labour for crops. In Costa Rica costs for 7 month old iguanas were calculated at US$2.48, including opportunity costs for labour (Pérez et al., 1993a). Gutierrez (1996) reports a retail price for young iguanas in Nicaragua ranging from US$ 1.5 to US$2.25. The average retail prices were given in Table 6. If cost prices in Costa Rica are extrapolated to Nicaragua and Panama, selling young iguanas would only be profitable in Costa Rica. Extrapolation of cost prices to Panama is justified because of the comparable GNP per head of the population (Table 1) and we have strong indications that the cost-prices are comparable between the two countries. Cost prices can be extrapolated to Nicaragua because of the reported

cost price for young iguanas of US$1.2 excluding labour and land opportunity costs (Paniagua, 1995). Twelve percent of the iguana farmers was selling adult iguanas. The costs for two-year-old iguanas were US$7.95, including opportunity costs for labour (Pérez et al., 1993a). In Panama, adult iguanas were sold for meat at a price of US$4 per kilo. After extrapolation of the Costa Rican cost prices to Nicaragua and Panama, selling adult iguanas would only be profitable in Costa Rica.

Extra income from iguana farming will depend also on future price trends. Producers in Nicaragua mainly supply animals to the pet market, but this market is small and prices fluctuate from profitable to clearly unprofitable (Sandlund et al., 1993). According to the farmers and officials we interviewed, the prices for young iguanas are decreasing in Nicaragua because of competition on the international market from other countries like Colombia, El Salvador, Guatemala, Suriname, Peru and Guyana. Iguana farmers were less optimistic about the future of farming iguanas than the other respondents, perhaps because the interview itself made the other respondents optimistic about the feasibility of earning an income from iguana farming.

The farmers that succeeded to amortise the capital investment over the period in production seemed to have a longer operational period than farmers who did not succeed. Farmers receiving assistance from NGOs where able to endure the initial period of production, when due to lack of experience the production fails, and when the selling possibilities have to be explored. Thus with the help of NGOs the initial obstacles were overcome and the farmers could obtain experience, before they were left alone to earn their additional income with iguana farming. The farmers, who did not get this support, stopped iguana farming because they were not able to sell their production, due to the obstacles common in starting iguana farming.

Producing animal protein

Only 12% of the iguana farms sold or gave away adult iguanas, of which most were sold as founder animals, thus only a very small proportion of the produced iguanas was consumed. This shows that producing animal protein is not yet an important production goal. Are there possibilities for market development for the consumption of iguana products? Perez et al. (1993b) report that 21% of the households they interviewed in Costa Rica have eaten iguana meat, of which 94% liked it; these consumers form a solid basis for marketing iguana meat. In this survey, 82% of the respondents consumed iguana meat and 65% consumed iguana eggs. These results seem to support the possibility of creating a market for iguana meat and eggs. The development of such a market will probably pose a serious threat to wild iguana populations, encouraging poaching. Sandlund et al. (1993) state that if the local people supply local and national markets with produced iguanas, illegal exploitation of wild populations may become

unprofitable. However, with the high cost prices for cultivated iguanas, it is felt that exploitation of the wild populations of iguanas will only stop if iguana has become almost extinct, so that catching will become unprofitable.

Amount of labour required

Pérez et al. (1993a) claimed that opportunity costs for labour could be ignored, because of the lack of alternative employment. This can be applied in case there is a surplus of labour, but actually the iguana farmers mentioned a shortage of labour. Iguana farmers found it difficult to take care of young iguanas during the wet season, when priority is given to producing food crops.

Ecological aspects of iguana farming

The expected ecological benefits of iguana farming are the increase of numbers of trees, to give a boost to nature conservation attitude, to gain more knowledge about and awareness of nature among farmers and to use locally available feed.

Increasing the number of trees

Former and present iguana farmers had a larger area of their farm planted with trees than neighbours, because NGOs have promoted iguana farming among farmers who had already planted trees or were interested in planting more trees. FAO in Nicaragua encouraged farmers by providing credit to plant trees. However tree-planting behaviour (also considered as a result of a positive nature conservation attitude) did not differ among farm types. The larger area of planted trees could be a spin-off from the contact of the farmers with NGOs: farmers with iguanas knew how and where to find financial resources to plant tree, and during courses they learned about the importance to plant trees and to protect existing trees on the farm. It is justifiable to contend that iguana farming does not directly increase tree numbers, but conserve the existing trees on the farm.

Positive nature conservation attitude and augmenting the knowledge about nature

The findings that iguana farmers were more involved in the implementation of nature conservation objectives on the farm than neighbours, supports the contention that iguana farming stimulates nature conservation attitude or that nature conservation attitude is found among iguana farmers. Iguana farming can stimulate nature conservation attitude by increasing the knowledge and awareness of nature with the courses iguana farmers followed or with the farmers' experiences with a wild species. On the other hand, NGO can stimulate iguana farming among farmers that show a positive attitude towards nature conservation. The differences among countries in how our respondents reacted to the word "iguanas" reflect differences in information supply about iguana farming. In Panama whole villages were approached about the

introduction of iguana farming, and its goals were explained to all people. In this way, more people learned that keeping iguanas meant that their habitat had to be preserved and this contributed to nature conservation attitude. However, by following more and more intensive courses, the knowledge of the iguana farmer about nature was augmented more than that of neighbours and former iguana farmers. Knowledge about predators also influenced farmers' attitudes: if they knew about the role of predators in nature, they deterred predators but did not harm them. Killing predators is contrary to nature conservation attitude, and may possibly be discouraged by farmers exchanging experiences about predators and by enhancing their knowledge of predators.

Locally available feed

Concentrates are still used to complement the diet of locally available feed, especially in the dry season when it takes a lot of time to collect sufficient fresh leaves, fruits and flowers. However, with an increasing number of iguanas the accent of feed supply will presumably shift to off-farm bought feed, such as market residues and concentrates.

Legislative aspects of iguana farming

Protection by law is preventing big companies from starting large-scale iguana farming in Central America and from pushing smallholder farmers off the market. In El Salvador and Guatemala large-scale iguana farming is obstructing smallholder farmers. The large-scale farmers are largely (and illegally) obtaining their stocks of iguanas from the natural forests of Nicaragua and Honduras to make good the losses that are suffered during breeding (Fitch et al., 1982; Menghi and Werner, 1994). Legislation and regulations on iguana farming and trade help governments to control the number of farms and the number of iguanas produced. They also protect smallholder farms. However, these laws and regulations are so complicated and rigid that they also deter smallholders from starting iguana farming. To apply for permission to keep and breed iguanas, the farmer has to submit a project proposal. This proposal has to be prepared by a professional in natural resources. In Panama the application has to be officially approved by a lawyer. After analysis of the project proposal, inspection of the farm and implementation of recommendations given by the management authority, the farmer is authorised to capture adult iguanas from the natural forest. Permission to export iguanas is granted when the regulations of CITES are fulfilled, the farmer has paid a fee to the government, a scientific authority has given approval, the registration of the iguana farm has been demonstrated and the international norms on transport of iguanas are complied with. For example, in Costa Rica iguanas are protected by very specific regulations and therefore only 4 farms have been able to meet the requirements for iguana farming; two of these are research and education farms, managed by professionals. However, according to Palacios (1994) the legislative limitations form no problems for the

smallholders and legislation can be advantageous, as the production of trees is tax deductible.

4.5 Conclusions

In 1997 the existing iguana farms consisted in resource-poor and resource-rich farms. A major economic constraint to iguana farming in all three countries is the initial investment, especially if no credit programmes are provided by banks, and smallholders depend on credit programmes provided by NGOs. If the initial costs and the absence of credit possibilities are taken into account, it becomes clear that a resource-poor farmer, without help, cannot start iguana farming with his own efforts and capital. On most farms the iguana activities were not able to generate additional income. Firstly, because most farmers were still struggling to earn back their investments. Secondly, because only in Costa Rica the sale of both young and adult iguanas was profitable, if labour costs were taken into account. The amount of labour required, consisting of protection, feeding and cleaning the cages, was considered a constraint during the wet period, when the priority is producing food crops. At this moment the production of animal protein is not important, because most adult iguanas are sold as founder animals. However the possibility to produce iguana meat seemed to be a feasible alternative for the pet-market and founder-animal-market. Fresh iguana feed is locally available and used on the majority of farms. However most farmers add concentrates to improve the growth of the iguanas reducing the amount of labour required, but increasing the cost price.

It can be concluded that the ecological benefits of iguana farming are tenable: a positive attitude towards nature conservation is found with iguana farmers, who incorporated it as an objective of their farm. Giving another purpose to the trees on the farm stimulates the conservation of trees, however the number of trees did not increase on iguana farms. Local feed resources are used, but it should be kept in mind that total reliance on local feed resources is only possible if the farmer has a small number of iguanas. Following courses and experience in observing their animals augments farmers' knowledge about nature. Farmers' attitude towards predators changes with increasing appreciation of the role of predators in nature; however, predators are still seen as a threat, which in fact they are: every iguana eaten by a predator is a financial loss to the iguana farmers.

The strict legislation is made to protect the specie *iguana iguana* and can serve to protect smallholder iguana farms from being pushed from the market by large-scale farms. However at the moment the regulations form an obstacle for the smallholder farmers to start iguana farmers and to trade their products.

Table 8. An indicative overview of the aspects of iguana production in three countries

	Nicaragua	Costa Rica	Panama	Overall
Economic [a]				
Land	-	+/-	+	+/-
Labour	-	-	-	-
Initial investment	-	-	-	-
Providing income	-	+	-	+/-
Providing protein	+/-	+/-	+/-	+/-
Ecological				
Feed	+/-	+/-	+/-	+/-
Trees	+	+	+	+
Predators	+/-	+/-	+/-	+/-
Nature conservation	+	+	+	+
Legislative				
Protection	+	+	+	+
Smallholders' possibilities	-	-	-	-
Implementation	-	+	+/-	+/-

[a] "+" means that the aspect is favourable, "-" means that the aspect is unfavourable

Table 8 gives an overview of the various aspects of iguana farming in the three countries. The prospects for the farming system depend on the weight attached to these aspects. From the smallholders' point of view, the unstable and risky economic prospects and the negative impact of legislation on starting iguana farming are very important, while from the point of view of nature conservation organisations the ecological benefits and the protective influence of the legislation are very important. If iguana farming is to be introduced successfully, all users have to be satisfied. "If resources do not represent anything beneficial for the people and if their conservation provides no additional benefits for the communities, it cannot be expected that they will conserve them" (Kaimowitz, 1995). Hence, the iguana farming system has to be adapted to satisfy the major actors, the farmers, increasing its profits and giving farmers professional help in meeting the statutory requirements for iguana farming.

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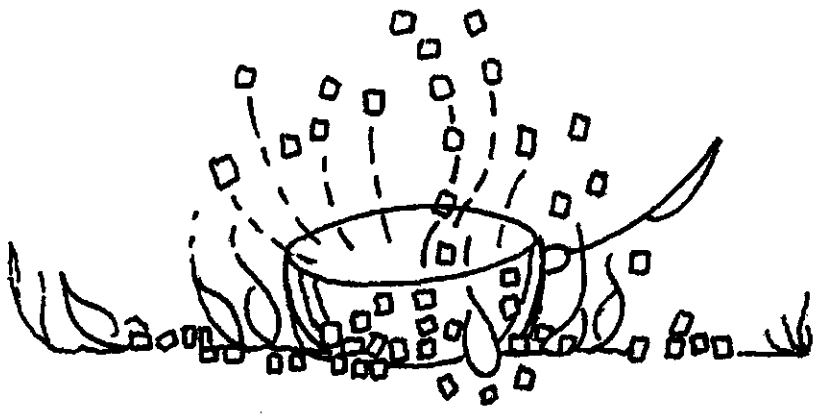

Sibö insisted, "Let's get closer to where I left the basket". Soon a sound could be heard, as if someone was toasting maize. Again Sibö asked the iguana, "Do you hear that?" The iguana answered, "I don't hear anything". Sibö did this to see if the iguana agreed with what was happening.

Chapter 5

Farmers' views on iguana farming in Central America obtained by 'cartoon' drawings.

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Submitted to ***Society and Natural Resources***

Abstract

The goal of this study was to assess farmers' views on iguana farms as systems in Central America, to describe a visualisation method to obtain these views and to discuss the problems encountered with this method. Respondents were asked to allocate components, either to farm or to environment and to indicate their importance; components were visualised by 'cartoon' drawings. Views differed among countries and respondents. Most respondents mentioned external components, not under farmer's control, as important. Discussing concepts with this visualisation method solved problems between respondents and interviewer caused by differences in sociolinguistic background, by words meaning different things in different regions.

Keywords: Iguana iguana, production system, interview method, visualisation

5.1 Introduction

Iguana iguana (green iguana) farming is a new farming system that was introduced in Central America in 1983 (National Research Council, 1991). Primary benefits expected from farming iguanas are to provide extra income for smallholder farmers and to stimulate nature conservation by discouraging farmers and others from poaching or slashing trees in the forest. Secondary benefits expected are to encourage production of animal protein; to increase the number of trees, by creating an on-farm habitat for iguanas; and to improve the farmer's knowledge about nature (Pérez *et al.*, 1993; Madrigal and Solís, 1994; Ruiz Rodríguez and Ascher, 1996).

The primary goal of this study was to assess farmers' views on iguana farms as systems in Nicaragua, Costa Rica and Panama. To obtain these views a survey was conducted in 1997 using a new visualisation method, in which components of a farm were visualised with 'cartoon' drawings made by the interviewer. The secondary goal was to describe the visualisation method and to discuss the problems encountered with the use of this method.

5.2 Materials and Methods

Assessment of farmers' views

In 1997, 24 iguana farmers and 24 non-iguana farmers in Nicaragua, Costa Rica, and Panama, were interviewed in Spanish about the purported socio-economic and ecological benefits of iguana production (Annex 1). Respondents were interviewed using an interviewer-completed questionnaire consisting of about 34 questions (for non-iguana farmers) to 65 questions (for iguana farmers); about half were formal questions and half open questions. We will focus on one specific interview item of that questionnaire. This item considers the farm to be a system composed of several components or subsystems and influenced by components of the environment (e.g. government, market). Each respondent was asked to allocate a list of components either to the farm or to the environment of the farm. The respondent was asked, furthermore, to indicate the importance of each component for the farming system as a whole and for a specific subsystem of the farm, namely, the production of iguanas.

How was visualisation used?

To facilitate this long and difficult item a qualitative approach was used: concepts describing components of the farming system and of the environment were visualised by 'cartoon' drawings. A pilot survey was conducted, with advisors of iguana production acting as respondents, to test if the visualisation item and the formal questions were understandable. Based on their response the survey was improved.

The following questions are about a farm with iguanas.
Here you have some drawings on cards that represent the following components:

1. farmer/manager	10. consumer	19. village
2. farmer's wife	11. woods-at-roadsides	20. advisor
3. children	12. fruits	21. government
4. iguanas	13. kitchen garden	22. veterinarian
5. compound	14. natural forest	23. merchant of iguanas
6. trees	15. feed merchant	24. sun
7. rain	16. off-farm job	25. harvest
8. predators	17. neighbours	26. farm animals
9. tourists	18. breeding farm	27. proprietor

28. other subjects.....

- Is this drawing part of the farm or not?

You can place the drawing belonging to the farm upon the orange rectangle.
You can place the drawing belonging to the environment upon the white border.

- Is this drawing important for the farm?
- Can you explain why the drawing is important/not important for the farm?
- Is this drawing important for iguanas?
- Can you explain why this drawing is important/not important for iguanas?

Interviewer: write the numbers of the cards belonging to the farm in the rectangle and the numbers of the cards belonging to the environment in the border. Write the explanation down in short notes for the farm and for the iguanas.

- Can you tell me which drawings belonging to the farm are important (the most important first)?
- Can you tell me which drawings belonging to the environment are important (the most important first)?

Box 1. Visualisation item asked to the respondents.

Box 1 describes the item, translated from Spanish. Components in Box 1 were visualised by 'cartoon' drawings. Each component was drawn especially for this study on a card, with the description written next to it (see Figures 1, 2, 3 and 4 for examples). Each card was shown to the respondent, and the meaning of the drawing was explained and discussed. A white paper (about A1 in size) with an orange rectangle (about A3 in size) in the centre was used to distinguish between the farm and its environment; the orange rectangle represented the farm and the white border represented the environment. The respondent was asked to place each card with a component that belonged to the farm upon the orange rectangle and to place each card with a component that belonged to the environment upon the white border. If the respondent was unable to allocate the component either to the farm or to the

Table 1. Allocation of components to the farm, to the environment or to both and importance of components to the farm or to the environment, according to the respondents.

Component	Allocation			Importance		
	Farm	Environment	Both	Farm	Environment	
	%			n		N*
Farmer/manager	100	-	-	24	-	47
Farmers wife	98	2	-	17	1	47
Children	96	4	-	17	1	48
Iguanas	88	4	8	9	2	48
Compound	98	2	-	6	1	48
Trees	100	-	-	13	-	48
Rain	42	50	8	9	19	48
Predators	34	55	11	1	6	47
Tourists	-	98	2	-	12	47
Consumer	21	48	31	1	9	48
Woods-at-roadsides	52	42	6	2	3	48
Fruits	94	6	-	3	1	48
Field	100	-	-	1	-	45
Kitchen garden	100	-	-	3	-	45
Pasture	100	-	-	3	-	45
Natural forest	75	21	4	16	4	48
Feed merchant	4	94	2	-	16	45
Off-farm job	5	95	-	-	4	39
Neighbours	13	87	-	-	11	46
Breeding farm of iguanas	88	8	4	8	3	48
Village	10	90	-	-	11	48
Advisor	20	74	6	1	15	46
Government	11	87	2	-	10	46
Veterinarian	20	76	4	2	14	46
Merchant of iguanas	13	85	2	1	15	46
Sun	48	46	6	13	18	48
Harvest	98	2	-	11	-	48
Farm animals	98	2	-	15	-	48
Proprietor	98	2	-	4	-	48

n = number of respondents who ranked the component among the first four, in order of importance.
* If N < 48 then percentages do not sum to 100%

46% outside), however, were difficult to place, because they were necessary for production, but beyond control. Respondents varied in placing components such as predators, consumer and woods-at-roadsides. Predators were prevalent inside (33%) and outside (54%). Consumer was found inside the farm, as a family member eating *Iguana iguana* (21%), and outside the farm, as a poacher (48%). Woods-at-roadsides was placed inside or outside the farm, depending on the location of the farm; either a road

crossed the farmland (52% inside) or a public road was next to the farm (42% outside). The first four components, according to degree of importance inside the farm, indicate that most respondents considered the farmer or manager (n = 24) as the most important, followed by the farmer's wife (17), their children (17), natural forest (16) and farm animals (15). Outside the farm, respondents considered the rain (19), sun (18), feed merchant (16), advisor (15) and merchant of iguanas (15) as most important.

Table 2 summarises the effects of components on the farming system. Most components were considered positive for the farm, except predators (64% negative), consumer as poacher (28%), off-farm job due to lack of time (24%) and government by establishing regulations that obstruct instead of encourage (20%). If the reason for the component was linked to the family, then the reason was identified mainly as economic, because the component was mentioned as being profitable for the family (e.g. kitchen garden, fruits, harvest or farm animals). The consumer is an exception: reason for the component was linked mainly to the family as the main consumer of iguanas (67%). The consumer, however, was not only considered to be a self-sufficient family member eating iguanas (57% economic), but also a condition for the functioning of the system (41% ecological).

Table 3 summarises the effects of components on iguanas. Components that were considered negative for the farm (Table 2) were also negative for iguanas, but generally to a greater extent. In addition, neighbours (27%), village (28%) and harvest (28%) had a negative effect on iguanas. Neighbours were considered negative because they complained about damage to their harvest presumably caused by free-ranging iguanas. The negative effect of the village was because the activity of the village scared the iguanas and chased them away from nesting and feeding places.

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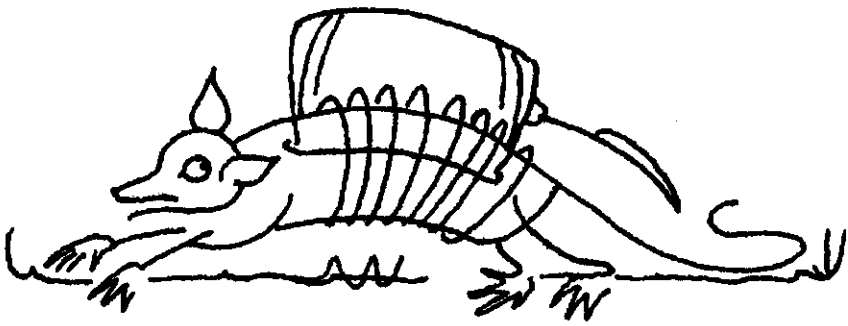

When Sibö arrived where he left the basket to the care of the armadillo, he saw that the armadillo had happily toasted and eaten the maize. Upon seeing the disobedience of the armadillo Sibö got so angry that he caught the armadillo by the jaw and squeezed until all the teeth were broken. He grabbed the armadillo and threw him to the ground several times. Then he took the pan in which the armadillo had toasted the maize and threw it on the back of the armadillo. The pan was so hot that it stuck to the skin of the armadillo. The armadillo finally succeeded in running away and hiding under the ground.

Chapter 6

Iguana production in Central America: prospects and constraints based on stakeholders' perceptions

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Abstract

Iguana production in Nicaragua, Costa Rica and Panama is a complex system with various stakeholders. In order to explore the opinions of stakeholders about iguana production, the system was discussed with two stakeholder groups: Farmers and Organisations. Organisations consisted of officials from government and non-governmental organisations. The stakeholders' discussions resulted in conceptual models of the system. These models were used to discuss problems, possible solutions and the feasibility of these solutions. Problems related to the market, to costs, the environment, information, reproduction, and legal problems were mentioned. Suggested solutions included presenting proposals to financiers, organising farmers, organising courses, and exchanging experiences.

6.1 Introduction

Smallholder farmers in Central America are limited with regard to the arable land available for agricultural production, because traditional slash-and-burn techniques used to grow basic food crops are associated with continuous deforestation and soil erosion (Gradwohl and Greenberg, 1988; Buffa and Werner, 1989; Pérez, 1994). During the dry season, when their plots are fallow, farmers exploit the surrounding natural forests to support their families by hunting wild animals, collecting firewood and extracting timber to sell, and wood and thatch to repair their huts (Gutierrez, 1996). Under current economic conditions, these unsustainable practices that exploit the forests constitute virtually the only option for resource-poor farmers to make a living. To reduce forest degradation, non-governmental organisations (NGOs) and government institutes in Central America have proposed green iguana (*Iguana iguana*) farming as an alternative.

Iguana farming started in Central America in 1983 (National Research Council, 1991), with a project by the Smithsonian Tropical Research Institute on reproduction of green iguanas in captivity. As a result of the success of this project, on-farm research began in 1985. At the same time, NGOs and government institutes promoted iguana farming to provide additional income for farmers, to increase protein consumption of the rural population, to protect an endangered species, and to raise consciousness about nature conservation (Pérez et al., 1993; Madrigal and Solís, 1994; Rodríguez and Ascher, 1996). This iguana production system was expected to be successful for several reasons. First, the iguana is a wild species that is easy to incorporate in smallholder farms, because it is adapted to a specific habitat of tree lines. Second, iguanas eat leaves, fruits and flowers that are inexpensive and easy to obtain. Third, there is a tradition for eating iguanas in Central America. Fourth, to maintain a viable wild population as a source of parent animals, forest borders and riversides must be conserved.

A formal survey of existing iguana production systems in Nicaragua, Costa Rica, and Panama in 1997 demonstrated that iguana production was a complex system involving various stakeholders (Eilers et al., 2001; Eilers et al., unpublished). The system involves social, economic and ecological factors that affect the farmer's use and management of natural resources. The farmer can influence only some of these factors; other factors, such as climate and legislation, are beyond control. Social, economic and ecological factors, natural resources and stakeholders can be considered components of a system that functions to reach a common goal.

Stakeholders are individuals or groups who depend on the production system to reach their own goals, and on whom, in turn, the production system depends (Johnson and Scholes, 1997). Different stakeholders may have different goals and different perceptions about the relative importance of the various components of the system.

Based on the formal survey, internal and external stakeholders could be distinguished. Internal stakeholders are farmers, owners, labourers and household-members. External stakeholders are governments (particularly the ministries dealing with wildlife management), NGOs, extension advisors, middlemen, wildlife scientists, consumers, suppliers and veterinarians.

Many problems associated with iguana farming are outside the control of the farmer, e.g., non-existent market infrastructures and the need for high initial investments. For a complete analysis of the constraints and opportunities of the complex iguana production system, all stakeholders need to be involved. Together, stakeholders can exchange ideas and experiences, and learn to understand each other's goals and opinions about iguana production. They may also be able to find solutions to the obstacles and complex problems associated with iguana farming.

The goal of this study was to explore the opinions of all stakeholders with respect to prospects and constraints of iguana production systems in Central America. For that purpose, these systems were discussed with stakeholders, using methods adapted from 'soft system methodology' (Checkland and Scholes, 1990), which resulted in conceptual models of the production systems. Using these conceptual models allowed problems to be discussed with stakeholders, give rise to possible solutions, and identified the feasibility of these solutions.

6.2 Material and Methods

The relative importance of stakeholders for the functioning of an iguana production system was assessed using answers from respondents to a formal survey. Two groups of key stakeholders were distinguished (Salomon and Engel, 1997). The first group (Farmers) consisted of iguana farmers, former iguana farmers, owners, household members, and labourers. Farmers use natural resources, such as wild iguanas, forest borders, and river basins to generate income and to conserve nature. The second group (Organisations) consisted of extension advisors, wildlife scientists, representatives of NGOs and of ministries dealing with wildlife management. Organisations use iguana farming to influence the farmer's use of natural resources.

A workshop was designed in which stakeholder groups discussed iguana production systems with respect to their strong and weak points, using the Strength-Weakness-Opportunity-and-Threat (SWOT) analysis (Balamuralikrishna and Dugger, 1995), which resulted in conceptual models (Checkland and Scholes, 1990). Stakeholders identified problems and suggested possible solutions for the weak points in the system. The feasibility of these solutions was discussed with stakeholders.

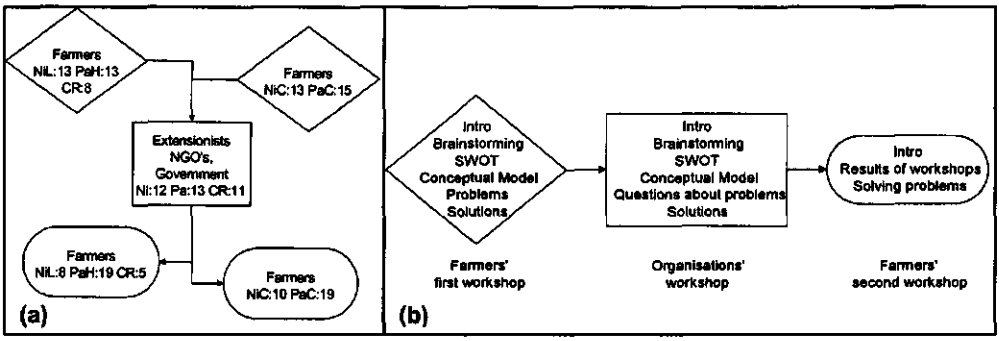

Figure 1(a) Organisation of the workshops with number of participants.

NiL = Nicaragua León
NiC = Nicaragua Chinandega
PaH = Panama Herrera-Los Santos
PaC = Panama Coclé
CR = Costa Rica
Pa = Panama
Ni = Nicaragua

Figure 1(b) Approach used in the workshops.

Workshops were first held with Farmers in Nicaragua, Costa Rica and Panama. These were followed by a workshop with Organisations and the process concluded with a second series of workshops with Farmers (Figure 1a). Twenty-three Nicaraguan Farmers and village heads (in Nicaragua only), 112 Farmers in Panama and 5 Farmers in Costa Rica were invited to participate with a colleague in a one-day workshop about iguana farming. Farmers from one (or two) provinces were assigned to one group to represent a specific region governed by the same council and to limit the travelling distances. One advantage of the small groups was that each participant had the opportunity to give his/her opinion.

Farmers and village heads from two northern provinces of Nicaragua (León and Chinandega) were assigned to separate discussion groups, each comprising 13 participants. Farmers from three provinces of Panama (Coclé, Herrera and Los Santos) were assigned to two discussion groups, one for the Coclé province with 15 participants and one for Herrera and Los Santos with 13 participants. Farmers from Costa Rica were assigned to one discussion group with eight participants. Organisations were invited to participate in workshops for which there were 12 participants in Nicaragua, 13 in Panama and 11 in Costa Rica. Finally, Farmers were invited again to discuss the results of the earlier workshops. There were 8 participants in León, 10 in Chinandega, 19 in Herrera/Los Santos, 17 in Coclé, and 5 in Costa Rica. In total, 13 workshops were organised (Figure 1a): five in Nicaragua, five in Panama, and three in Costa Rica.

Approach to the Farmers' workshops

One moderator presided over each workshop, leading the discussion and making notes on a flip-over chart for everyone to read. The workshop consisted of plenary sessions and started with a round of introductions. Next, there was a brainstorming session based on the question: 'What comes to your mind when you think about iguana farming?' The session resulted in identification of the critical components for iguana production systems, which were used in the SWOT analysis. If a farmer could influence the component, it was situated within the system and classified as positive (strength) or negative (weakness). If a farmer could not influence the component, it was situated outside the system and classified as positive (opportunity) or negative (threat). The SWOT analysis was used to identify the positive and/or negative influences of each component on the iguana production system. The system and its components were visualised in a conceptual model that summarised the results of the SWOT analysis (Figure 2). The model identified weaknesses and threats (problems) and their order of importance. Possible solutions for each problem were then discussed with the participants.

Approach to the Organisations' workshops

A one-day workshop was organised in each country (Figure 1b). Methods used in these workshops were identical to those used with Farmers through to the conceptual model, except that the SWOT analysis was performed in small groups to give each participant the opportunity to express his/her opinion on each component of the analysis. After summarising the group discussions in a conceptual model, participants answered questions resulting from the Farmers' discussion about the problems. The workshop concluded with a plenary discussion about problems and possible solutions.

Approach to the second workshop with Farmers

A second one-day workshop was organised for each group of Farmers, during which they were informed about the results of meetings with the other groups of Farmers and with the Organisations. Possibilities for jointly solving problems were discussed.

6.3 Results

The results of workshops with Farmers and Organisations are in Figure 2. Conceptual models from the first workshop with Farmers were combined to show the components and problems mentioned most frequently. Specific regional differences in components that affect iguana production were identified among countries in the conceptual models, but were not included in Figure 2. In Nicaragua, there were middlemen who bought young iguanas from farms and exported them as pets. In Panama, farm management and management of the rural community were considered important. (Management of the

rural community means teaching people that the release and protection of iguanas can result in selective consumption of iguanas without danger of their extinction.) In Costa Rica, farmers lacked organisation, and the protection of iguanas was considered an important but time-consuming job.

Problems identified by Farmers together with their suggested solutions, are presented in Table 1. The main problems were related to the market, costs, environment, information, on-farm and off-farm problems. Market-related problems were mentioned in each country. Only in Nicaragua, however, did a sector of middlemen develop strongly influencing prices to their own advantage. According to Farmers, solutions to the market-related problems included studying the market, organising farmers to increase their influence on the market and prices, and developing new markets, for example, opening restaurants and attracting tourists.

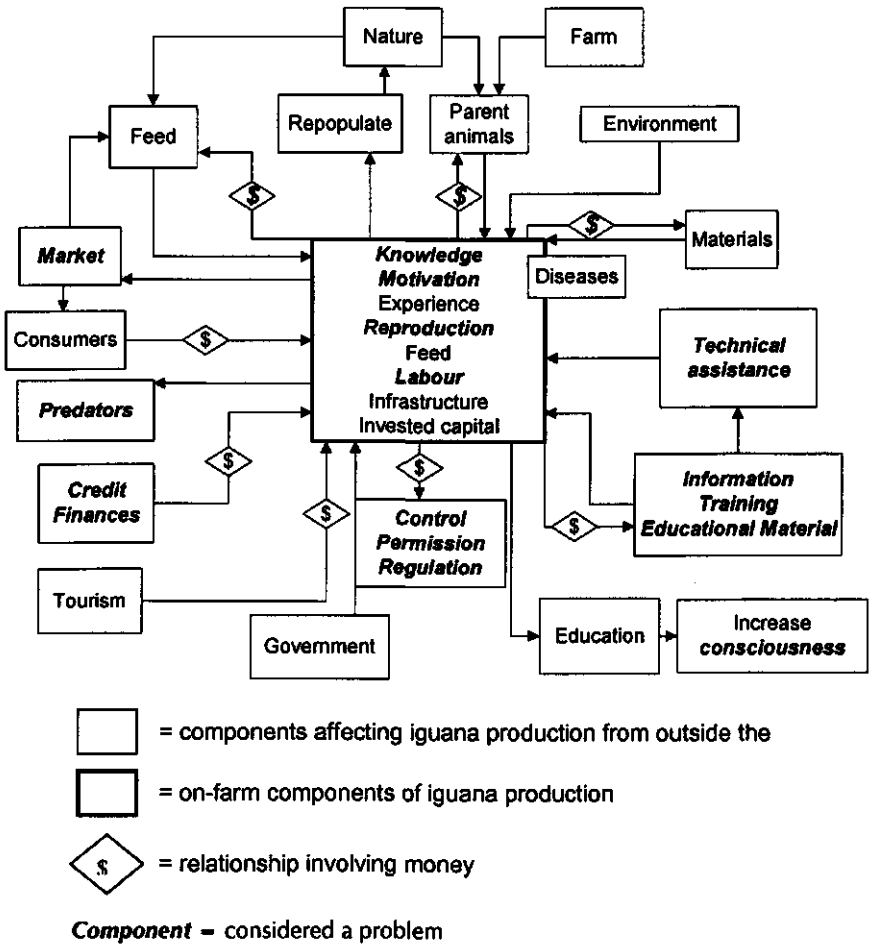

Figure 2. Conceptual model of iguana production systems.

Cost-related problems were identified in each country, but there were no easy solutions. Cultivating iguana feed or searching for feed in nature, for example, reduces feed costs, but greatly increases labour requirements. Using locally available material to build iguana cages could reduce costs of materials. Iguanas, however, are good climbers, thus the zinc plates used for cages could not be replaced by locally available material.

Table 1. Problems identified by Farmers and suggested solutions by country.

Problem	Nicaragua		Costa Rica	Panama	
	León	Chinandega	Farmers	Coclé	Azuero
Market					
No market developed		13,20			14
Middlemen	20	20			
No knowledge of market			10	10	
Costs					
Costs of feed		?	4,6	6,7	6
Costs of materials			?	12	?
Costs of labour	18,19				11
Environment					
Theft/predators	24		8,26	26	13,26
No feed available in nature	5,6			4,6	
Information					
No information / literature		1,2		1,2,3	1,2
No technical assistance / education	?	1	16,17	?	2,20
On-farm problems					
Diseases		1,2	15	?	
Little knowledge about production	1,2		3		
Lack of motivation			21,22		
Reproduction problems/ low production	27	?	2		2,20
Off-farm problems					
Lack of organisation among farmers	20	20			
No finance	20,23	20,23	23		
Obtain permission	20,25	?	25	9	
Wild parent animals not available or die in captivity	?	?			

1. Exchange experiences
2. Organise courses
3. Search for information / educational material
4. Search for feed in nature
5. Watering plants
6. Plant trees, cultivate feed
7. Buy large quantities as association
8. Open hunting area
9. Recommend to government
10. Investigate market
11. Incorporate family
12. Use local materials
13. Develop market
14. Open restaurant
15. Reproduce naturally
16. Interest technicians in iguanas
17. Search for experts in iguana farming
18. Be motivated
19. Plan your time
20. Organise farmers in an association to negotiate
21. Communicate among employees
22. Avoid problems on-farm
23. Visit financiers/ present plan
24. Use net to prevent predation
25. Discuss simplification of rules
26. Educate by being an example
27. Increase number of parent animals

? = No solution given

At the end of each workshop, participants had the opportunity to give feedback comments. Most farmers and extension advisors said that they were grateful for the workshop and that they had learned more, than during a formal course, because of the exchange of experiences and ideas.

The use of SWOT analysis and conceptual models in workshops confirmed their usefulness. The added values of the methods for the researcher included: a better understanding of a new production system and its constraints, solutions to these constraints and establishing the possible impact of these solutions on iguana farming. The added value for the participants was explicit awareness about iguana farming in their country. Furthermore, stakeholders had the opportunity to meet other stakeholders, to exchange ideas and experiences, and to initiate some of the proposed solutions.

6.5 Conclusions

Stakeholders' perceptions confirmed the existence of constraints found in an earlier formal survey. These constraints can be alleviated if iguana farmers organise themselves to communicate as a group with governments, NGOs, extension advisors and middlemen. In Panama, constraints encountered by experienced farmers were considered most important, emphasising the need to develop an educational scheme, organise of courses, develop educational material, and reduce production costs. In Costa Rica and Nicaragua, however, constraints experienced by new farmers were considered most important, emphasising the need to provide credit schemes and organise farmers so as to overcome problems with the market and with regulations.

In any case, iguana farming may be feasible when the following requirements are met:

- Simplification of laws and rules to apply for permits and licences;
- Improvement of the enforcement of regulations;
- Creation of an association of iguana farmers that uses a percentage of its profit to pay for legal advise, transportation costs, courses, and communication;
- Cultivation of iguana feed on farm;
- Assistance of NGOs in:
  - Developing credit schemes for new farmers;
  - Organising courses and educating extension advisors;
  - Organising farmers, providing subsidies for meetings, and providing the organisation with initial capital;
  - Developing and distributing educational materials;
- Development of credit schemes with national financial institutes;
- Introduction of "conservation of nature" in the educational programme of primary schools to raise consciousness;

- Development of an educational programme for courses, workshops and on-the-job training.

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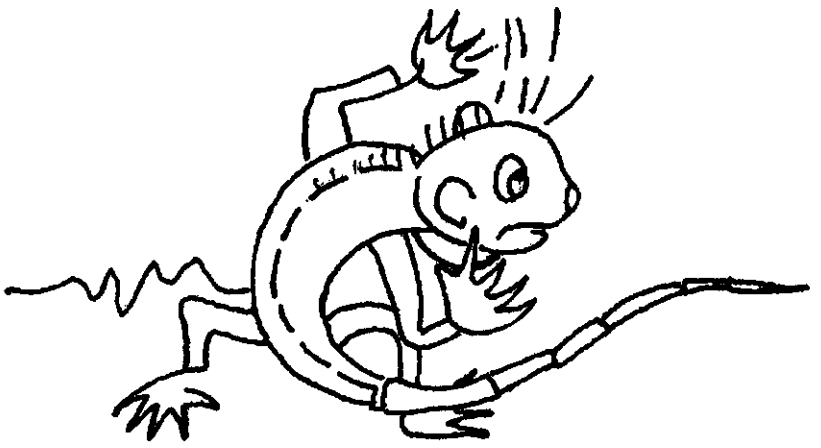

Sibö also beat the iguana furiously. "Why did you cheat on me, telling that you didn't hear a sound? You will be punished for that!" shouted Sibö. He smacked the ears of the iguana.

Chapter 7

Introduction and development of new production systems with non-traditional animal species with special attention to the development of iguana production.

C.H.A.M. Eilers and W.J. Koops

Submitted to ***Outlook on Agriculture***.

Abstract

The objective of this study is to compare the development of iguana production systems in Central America at different phases of their development with the introduction of other new production systems with non-traditional animal species. Experts on new production systems with non-traditional animal species: i.e. pacas, vicunas, grasscutters, deer, bison, eel, tilapia, catfish and ostrich, were interviewed about their experiences with the development of new systems. The study revealed six important factors for introduction and development of new production systems with non-traditional animal species. These factors can be distinguished in conditions that are needed to start a new production system: biology, support and market; and in limitations that can impede the development of new production systems: information, social conditions and legislation. Comparing the factors among production systems, therefore, enables us to explore the development of production systems and their prospects and constraints. Studying the key factors for iguana production in Panama predicts the development of the system and identifies its most important constraints. All key factors were negative for iguana production. If the conditions for iguana production do not change, the diffusion of iguana production will reach a plateau or even drop. In spite of the formation of associations and the exchange of information and experiences among farmers, advisors and other stakeholders, the diffusion of the production system will run into the *restricting conditions of the non-existing market for iguana products, lack of support and* biological problems in iguana production.

Keywords: *production system, development, non-traditional animal species, conditions and limitations.*

7.1 Introduction

To introduce and develop successfully new production systems with non-traditional animal species, their constraints and prospects have to be investigated on the basis of a small-scale introduction, so that adaptations to improve these systems can be recommended. The case study of iguana production systems in Central America showed how to investigate the development of new production systems and how to identify their prospects and constraints (Eilers et al., 2001a; Eilers et al., 2001b; Eilers et al., 2002; Eilers et al., 2002). From a formal survey and a stakeholder-based analysis of the iguana production systems it appeared that the constraints of iguana production included components that the producer could not influence. Stakeholders evaluated the situation of iguana production and suggested recommendations to improve the situation for iguana farmers (Eilers et al., 2001b).

The introduction of new production systems can be described as a diffusion of innovations. The main elements in the diffusion of new ideas are: (1) an innovation, (2) which is communicated through certain channels, (3) over time, (4) among members of a social system (Rogers, 1995). In the present study, the innovation consists of the production system with non-traditional animal species, perceived as new by an individual (farmer/advisor). The characteristics of an innovation, as perceived by members of the social system, determine its rate of adoption. New production systems that are perceived by farmers as having greater relative advantage, compatibility, trialability, observability and less complexity will be adopted more rapidly than other innovations. Communication channels can be divided in two groups: mass media channels and interpersonal channels. Mass media channels, for example, journals or papers reporting on a new production system, are effective in creating knowledge of innovations (awareness of their existence). Most farmers evaluate an innovation, however, not on the basis of research by experts, but through subjective evaluations of near-peers who have adopted the innovation. These interpersonal channels form and change attitudes towards a new production system and thus they influence the decision to adopt or reject that system.

Time is involved in diffusion by the degree to which a farmer is relatively early in adopting the new production system than other farmers. Rogers specifies five adopter categories on the basis of their innovativeness: (1) innovators, (2) early adopters, (3) early majority, (4) late majority and (5) laggards (Figure 1). Time also is involved in the rate of adoption, i.e. the relative speed with which members of a social system adopt an innovation. A social system for example, is a community in a certain region with norms and behaviour patterns that facilitates or impedes (in combination with the communication structure) the diffusion of an innovation in the system.

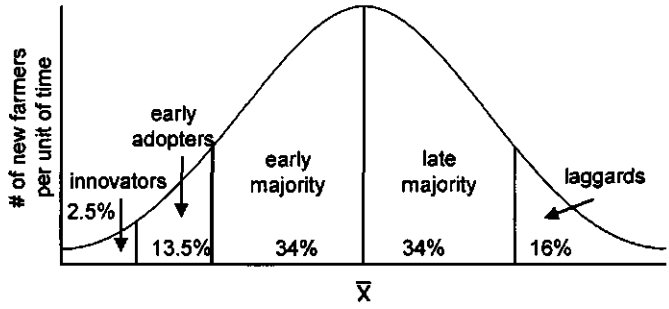

Figure 1. Adopter categorisation on the basis of different innovativeness.
Source: Rogers, 1995

Rogers' model of the diffusion of innovations does not take into account the discontinuation of the innovations, e.g. farmers that discontinued to use a production system. Rogers mentions, however, that the discontinuation can be an important factor of the diffusion. Experts mentioned the strong influence of these discontinued farmers on the diffusion of the new production system. I distinguished four phases in the diffusion of new production systems, with which the discontinued farmers can be taken into account. The four phases in the development of new systems are: introduction of the system, evaluation of the introduction, application of the system on a large scale and development of the system in the long term (10-15 years after its introduction). Application of the system on a large scale means that more farmers adopt the system.

It is hypothesised that the development of iguana production systems can be compared with trends and trade-offs in the development of new production systems obtained from a survey among experts on new animal production systems. The objective of this study, therefore, is to compare the development of iguana production systems in Central America at different phases of their development with the introduction of other new production systems with non-traditional animal species. The Panamanian situation of iguana production is compared with the other production systems because in Panama, iguana production was introduced first and thus is in the most advanced phase of development.

7.2 Materials and Methods

Experts on new production systems with non-traditional animal species were interviewed by means of a written survey about their experiences with the development of the system (Annex 5). Experts are defined as individuals actively involved in the introduction of the new animal production system, and thus they belong to the initiators or are researchers who study the development of the animal production system.

Table 1. Description of new animal production systems according to the experts

Production system	Country	Indi-genous	Starting year	Initiator	Target group	Objectives*
Pacas	Panama	Yes	1982	NGO	Smallholders	4 5 6 13 12 14
Iguanas	Panama**	Yes	1985	NGO	Smallholders	1 2 3 4 5 6 7 11
Vicunas	Bolivia	Yes	1996	NGO-govern	Smallholders	1 2 4 5 6 14
Grasscutters	Benin	Yes	1968	NGO-gov-uni	Smallholders	1 6 7
Deer	Indonesia	Yes	2000	Gov-research	Farmer/Com	1 4 6 7 9 15
Deer	Australia	No	1971	Private farmers	Pr. Farmers	1 7 8 9
Deer	New Zealand	No	1969	Private farmers	Large farms	1 2 7 8 9
Bison	France	No	1986	Farmers	Remote area	1 4 16
Eel	Netherlands	Yes	1980	Company	Farmers	1 10
Tilapia	Netherlands	No	1999	Company	Pig farmers	1
Catfish	Netherlands	No	1985	University	No group	1 12
Ostrich	Netherlands	No	1990	Company	Small farms	1 2 3

*1 = meat, 2 = hides, 3 = eggs, 4 = tourism, 5 = education, 6 = conservation of species, 7 = income, 8 = velvet, 9 = antler, 10 = small eel, 11 = breeding material, 12 = research, 13 = selfsufficiency, 14 = creating awareness, 15 = fill gap demand-supply, 16 = use resources

** Panama is chosen because it has the longest experience in iguana production

Animal production systems are systems in which animals are reproduced with a specific objective that may vary from nature conservation to the production of meat. "New systems" are defined as systems existing less than forty years, so that one expert can consider from experience the entire life cycle of the production system.

With this written survey, we wanted to understand the development of these systems, their prospects and their constraints. The survey consisted of 32 questions, which were partly formal and partly open-ended. The survey distinguished four phases in the lifecycle of "new" animal production systems:

Phase 1: Introduction of the new production system on a small scale (as a pilot).

Phase 2: Evaluation of the introduction of this system (evaluation of the pilot).

Phase 3. Application of the system on a large scale

Phase 4: Development of the system in the long term

Experts were asked to share their experiences and express their opinion about the procedures for each of these phases.

7.3 Results

Table 1 describes new animal production systems. Five systems were situated in developing countries and seven systems were situated in developed countries. In the developing countries, all systems had indigenous species, which implied that the animals were hunted traditionally for meat, hides, wool or eggs. These animals sometimes were used for offering. The hunters are familiar with the habitat of the animals, with what the animals eat and how they behave. In developed countries, there

Table 2. Key factors: conditions and limitations for new production systems as perceived by experts; see text for explanation.

System	Conditions			Limitations		
	Biology	Support	Market	Information	Social	Legislation
Pacas	-	-	-	-	-	-
Iguanas	-	-	-	-	-	-
Vicunas	-	-	-	-	-	-
Grasscutter	-	0	+	-	-	0
Deer Ind	-	-	-	0	-	-
Deer Au	-	-	-	0	-	-
Deer NZ	-	+	-/+	0	0	0
Bison	-	-	-	-	-	-
Eel	-	-	-	-	0	-
Tilapia	-	0	-	-	0	0
Catfish	0	0	-	0	0	0
Ostrich	-	-	-	-	-	-

+ = expert mentioned aspects of the factor as positive for production system

0 = expert did not mention factor

- = expert mentioned aspects of the factor as negative for the production system

was a trend to introduce exotic species that need special care because of the constraints imposed on animals living outside their original habitat.

The different systems are in different phases of their development; some have started recently, others are well-established. In developing countries, non-governmental organisations (NGOs), government and researchers are the initiators of the systems aiming at mostly a well-defined target group: smallholders in a specific region or village. In developed countries, however, the initiative mostly is taken by individual farmers or companies without a specific target group.

The objectives of production systems with new animal species are numerous in developing countries and vary from well-defined objective, such as meat and egg production to generate an income, to less-defined objectives, such as conservation of species, education, tourism and creating awareness. The objective of production systems in developed countries is to generate income by production of meat, velvet or other products, although the objective of generating income is mentioned less frequently.

The survey revealed six key factors important for development of a new production system (Table 2 and Figure 2). The first three key factors are conditions needed to start a new production system: biology, support and market. Biology of the species includes the behaviour of the animal, the possibility to breed the species in captivity

limitations. The system also was applied in other countries (National Research Council, 1991). Problems were lack of grasscutters to satisfy the demand for parent animals, lack of advisors to give technical assistance in neighbouring countries and the low level of domestication of grasscutters: they are not yet accustomed to living in captivity. The expert believed that the demand for grasscutter meat would be satisfied in 10 years. Keeping grasscutters more economically to maintain the level of income with a decreasing demand is not an option because of the biological problems.

Deer in Indonesia

Deer were introduced with courses and study groups in Indonesia in 2000. Biological problems with the introduction were the nervous behaviour of deer and the difference between species introduced on-farm and species prevalent in the wild. Lack of feed during dry season was also a problem. There were no donors and there was no budget for research. The deer system was expensive to introduce, had high prices for feed and it competed with wild deer products obtained by poaching. The system was not evaluated, but one of the limitations was the legal protection of deer. Another limitation was the current unstable political situation, which restrained investors from investing more money in the system. Experts recommended studying the feasibility of deer production in Indonesia and giving more technical support to deer farmers. The system is still in its introduction phase, so it has not yet been applied on a large scale. Prospects for deer production are positive (according to the expert), because of the high demand for meat on Java and the proven technical feasibility of deer farming in New Zealand and Caledonia. This will be true only if the economic feasibility and the development of a market is demonstrated in Indonesia.

Deer in Australia

Deer were introduced on private farms in Australia in 1971. Biological problems with the introduction of deer were the introduction outside their habitat (climate unsuitable for feed production), their nervous behaviour and presence of predators. The progress and diffusion of the system was completely farmer-driven with neither subsidies nor support from government. Deer production needed high investments, there was a lack of processing facilities and sales prices were low. The system was evaluated by monitoring the number of farms. Social limitations were the lack of interest in the new species, poachers and the non-acceptance of deer as farm animal. In some states deer were legally protected. The application on a large scale happened slowly while laws were adapted. Deer moved from being "protected" to being a normal farm animal. The industry became better organised by the consolidation of associations into one and improved access to abattoirs. The EU-accredited abattoirs used their status to keep the price they offered to farmers down, causing farmers to leave the industry (declining number of farmers in 1995 in Table 3). Improved access to EU-accredited abattoirs

increased the number of farmers. The international market for venison is well established. Expanding the deer production is possible by developing a national market and Australian velvet processing industry, obtaining government support for technical assistance and defining better the status of farmed deer.

Deer in New Zealand

Deer was introduced on private farms in New Zealand in 1969. Biological problems with the introduction of deer were its behaviour and diseases (National Resource Council, 1991). During the introduction, the price of deer rose above their commercial value by outside investment and the system needed high investments (Yerex and Spiers, 1990). Deer production, however, had the advantage of an already existing export market for wild venison on which the system could build. Farmers were supported by government funded research. The system was evaluated by interviewing farmers. As a result of the evaluation the system was adapted: the price of deer collapsed and it now reflects their commercial value. There was an on-going technical and economic evaluation of the production system, although an evaluation on a national basis could be useful. The system was applied on a larger scale and is growing at about 15% per year. During the application, a slight problem with water quality and soil erosion arose. There was a risk of production expanding faster than demand. More investments were made in fences and animals. Deer farms were getting bigger, many of the small herds that developed when prices were high and investors were involved had left the industry. The industry is expanding and the markets for venison in particular seem positive. The positive market development has been helped by bovine-somatropine-encephalitis and foot-and-mouth-disease scares in Europe. Returns from deer are competitive with sheep and beef.

Bison

Bison were introduced on private farms in France in 1980. Biological problems with the introduction of bison were their aggressive behaviour, their small number of offspring and diseases. There were neither funds nor subsidies to support the production system. Technical and management problems, however, were studied. The system was expensive to introduce. There was neither a market for bison meat nor an infrastructure. Bison meat had variable and decreasing prices, depending on the importation from America. The system was evaluated by monitoring the number of farms. Limitations were the need to pass an exam to obtain a permit for keeping bison (this reduced the number of interested people), lack of available knowledge and the non-acceptance of bison as a farm animal. Bison were easy to keep in the free range without further manipulation, but this was not allowed under the European legislation. The system was not applied on a large scale because of economic reasons, lack of subsidies and regulation: the diffusion stopped with 30 farmers (Table 4a).

Eel

Eel were introduced on private farms in the Netherlands in 1980 with courses, subsidies, credit and study groups. Biological problems were the incapacity of eel to breed in captivity and a lack of young eel from the wild (Dekker, 1998). In addition, there was a high mortality of adult and young eel due to diseases, problems with water quality and low quality feed. No organisations supported eel production and there were no subsidies. Eel production system was expensive to introduce, there was no market for the products (which caused bankruptcy of some farmers) and there was no infrastructure. High prices were paid for young eel, labour, land and feed, and the sales price was low. Eel production was evaluated by interviewing farmers. There was lack of available knowledge about the system and few veterinarians were specialised in eel. The slaughtering was not regulated and it was not clear if it was considered an agricultural or industrial activity. The introduction phase cost too much money because of duplication of efforts among pioneers. The system was adapted to apply it on a larger scale by increasing productivity with technical improvements for water clearing, improving health care (more knowledge about diseases and prevention), using regular merchants and improved feed (Van Zwieten, 1998). Institutes gave courses and on-the-job-training, and regulations for wastewater were applied. In the 1990s, the demand for eel meat grew strongly, which resulted in an increase in the number of farms between 1985 and 1995. At present, the number of farms has not increased, the production has grown by scale enlargement. The market for eel meat is satisfied, however, and the availability of young eel still is a problem. If eel cannot be reproduced in captivity, the eel production will not be able to grow anymore.

Tilapia

Tilapia was introduced on private farms in the Netherlands in 1999. Biological problems with the introduction were diseases and high mortality of adults. There was no market for tilapia. The price for feed was high. The system was evaluated by judging production data after slaughter. There was lack of available knowledge. Many technical problems did occur in an early stage of production, but these problems were not solved. Professional management and technical adaptations could improve the performance of the system. The system is not yet applied on a large scale, because it is still in its introductory phase and first the feasibility on the starting farms has to be proven. Other countries show interest in tilapia production and the competition from tropical countries may increase.

Catfish

Catfish was introduced on private farms with theme-events for associations in the Netherlands in 1985. There was no market and sale prices were low. Although there was no knowledge about this market, the expectations of the market were high (Van

Zwieten, 1998). The system was evaluated by interviewing farmers. Experts recommended to develop the introduction gradually, not based on 'gold-fever' mentality (the high expectations of the market were not met, causing a sharp decrease in the number of farmers: Table 4b). The system was technically improved and applied on a larger scale. This application on a larger scale could be improved by chain agreements about product quality, marketing and diversification. At present, the sector is reorganising, and if the reorganisation is done well, there are a lot of prospects. The cost price decreased drastically, so the system became suitable for developing countries as well.

Ostrich

Ostrich was introduced on private farms with study groups and organising hobby farmers, in the Netherlands in 1990. Biological problems with the introduction were the behaviour of ostrich (Wagemans and Bisseling, 2000), diseases, poor reproduction and difficulty to obtain parent animals, which resulted in poor quality animals used as parent animals. There was no budget for research. The system was expensive to introduce. There was no market for the products and there was no infrastructure (Wagemans and Bisseling, 2000). Prices were high for labour and land, but sale prices were low. The system was evaluated by interviewing farmers. Limitations were the non-acceptance of ostriches as farm animals, lack of available knowledge about the system and the restricting law for animal welfare (Wagemans and Bisseling, 2000). In the beginning, the information was unreliable. The results were lower than expected because of low prices and difficulties in selling. In the beginning, the product was seen as exclusive because of the high prices for hides. With the enlargement of the market, the quality of the end product was not properly considered. After 2 years, the fortune hunters, who thought to become rich quickly, left the industry and the farmers, who wanted to supplement their income, stayed (Table 4b). At present, more knowledge is available. The system is adapted with a larger area available for the animals, improved growth of chicks, exchange of information and study groups. For ostrich, the leather market is indispensable and introduction on the meat market is difficult due to other meat competitors. The system can be adapted in small steps to improve the welfare for the animals. It is envisaged that an economic ostrich system is possible in the Netherlands on the basis of an increasing demand for meat with a reasonable price and an increase in the sale possibilities for leather products (Wagemans and Bisseling, 2000). It is recommended to stop the diffusion of ostrich on new farms and to improve the exchange of useful information.

The general trends and trade-offs in the development of these production systems are described per phase of development.

Introduction phase

All systems were first tried on an experimental farm, although not always in the same country. For vicuna, the experimental farm was in Peru; for bison, in Canada and the USA; for tilapia, in Asia; and for ostrich, in South Africa. There were problems with the experimental farm being in a country other than being in the country where the production system was introduced: For vicuna, when the Peruvian NGO stopped, the expertise was gone. For bison, the feasibility of the system was never tested in European conditions. For tilapia, the small farms (4-6) functioned as experimental farms and these farmers took a high risk. For ostriches, the feasibility was never tested, and the system needed many adaptations but still could not meet the high expectations of the farmers.

Most species are still in the beginning of the domestication process: they are aggressive (bison, paca, grasscutter) or do not reproduce in captivity (eel). This causes problems during the whole process of development of the new production system.

Evaluation phase

Most systems were evaluated by interviewing farmers, and mostly the market was not taken into account. Market problems were mostly impossible to solve. Recommendations after the evaluation were related to solving biological and information problems with technical solutions and these solutions mostly increased investments. The systems with an already existing and stable market (e.g. venison export from New Zealand) had the greatest opportunities to develop. New production systems with a stable market, but with little support and in different social conditions had less success (e.g. deer in Australia or Indonesia).

Application-on-a-large-scale phase

Application on a large scale occurred only if the potential of the system was recognised by farmers or organisations that supported the production system. If this did not happen, then the system did not overcome the limitations and restricting conditions. No research was initiated and no exchange of information started.

Development-in-the-long-term phase

According to all experts, the development of the production systems in the long term depended primarily on removing biological obstacles. If there were no biological obstacles, then the market influenced mainly the development. With an increase in demand (or a stable demand with a possible decrease in production costs), the future of the system was seen as positive.

7.4 Discussion and Conclusions

The objective of this study was to compare the development of iguana production systems in Central America at different phases of their development with the introduction of other new production systems with non-traditional animal species. The study revealed six important factors for the introduction and development of new production systems with non-traditional animal species. These factors can be distinguished in terms of conditions, biology, support and market, and in terms of limitations, information, social conditions and legislation (Table 2). The biology of the species, as expressed in its behaviour, reproduction, number of offspring per year, habitat and feed requirements and causes of mortality, is the most important condition defining the possibilities and the structure of the production systems. If a species with positive biological prospects (ability to reproduce, with high number of offspring) is chosen, the other conditions become important to enable introduction of the system. The biology of the species is incorporated in studies to explore the possibilities to use new species for the production of protein, hides or other products. As a result of these studies, researchers claim that numerous species have the potential to contribute to these production goals (Vietmeyer, 1985; National Research Council, 1991; World Future Society,1992; Wilson, 1995; Biasatti et al., 1999).

The market possibilities of the species and its products is expressed in existing markets (e.g. market of wild meat, eggs and hides) and in infrastructure such as processing industry, middlemen and suppliers. Institutional support is expressed in financial support of banks, NGOs or government and in technical assistance and research. If no market or infrastructure exists and no markets or infrastructures are expected to develop, the production system cannot be introduced. The production system cannot be introduced also in the case of lack of support, especially if the target group is resource-poor: the group is unable to adopt the production system because of lack of finance or knowledge. If the conditions, biology, market and support, are satisfied, even partly, innovators will start to adopt the new production system (Figure 2). These conditions, support and market, are often mentioned but rarely studied by stakeholders (e.g. researchers, NGOs, governments or innovators) before the introduction of a new system. Wilson (1995), for example, mentions inadequate marketing and processing channels, lack of government support policies and extension services and inadequate adaptive research as factors operating against rabbit production in the Caribbean. He concludes, however, that given the circumstances rabbit production performance is still reasonable and could be improved with increased inputs and better management, which are technical solutions that increase cost price, but do not solve market and support problems.

model of Rogers can help us only partly to predict the development of iguana production.

Studying the key factors for iguana production in Panama explored the development of the system and identified its most important constraints. All key factors appeared negative for iguana production (Table 2). This was the same for pacas, Vicunas, bison and ostrich. The development of these systems indicated that if the conditions, i.e. biology, support and market, would not change, then the diffusion of iguana production would plateau or even drop (Table 3, pacas; Table 4b, ostrich). The system can be adjusted so that the limitations become less restricting: the exchange of experiences partly solves the lack of information. The restricting social conditions can be avoided by education about nature conservation and adaptation of the system to decrease labour requirements. Legislation in Panama is simplified to make it easier for farmers to comply with the legislation and to improve the control possibilities (Eilers et al., 2001a; Eilers et al., 2001b; Eilers et al., 2002). In spite of the formation of associations and the exchange of information and experiences among farmers, advisors and other stakeholders, the diffusion of the production system will run into the restricting conditions of the non-existing market for iguana products, lack of support and biological problems in iguana production.

Organisations started to introduce iguana production systems in Nicaragua and Costa Rica, while only a few innovators had adopted the system in Panama. This resulted in a number of disillusioned farmers and a lot of problems because the system was not feasible. Apparently the production system was not ready for a more general adoption. In Panama, however, the system continued to be adapted by innovators and now several early adopters had started (without the support of NGOs, universities or governments). The early adopters still felt restricted by limitations and this was where organisations could start to stimulate production, e.g. by changing legislation to simplify the adoption of the production system and trade in iguanas.

7.5 Acknowledgements

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and representatives of NGOs and of ministries dealing with wildlife management. They used iguana farming to influence the farmers' use of natural resources and were able to influence some of the external components of the system (Eilers et al., 2001b).

Both stakeholder groups discussed the iguana production systems in workshops using Strength-Weakness-Opportunity-and-Threat (SWOT) analysis, which resulted in conceptual models. These models were used to discuss problems, possible solutions and the feasibility of these solutions (Eilers et al., 2001b). SWOT was originally a management technique developed in business schools to identify factors important in the production process. On the basis of these factors a conceptual model of the production system was developed and in the model prospects and constraints of the production system were indicated. SWOT appeared to be an appropriate method to evaluate the actual situation and the possibilities for improvement of animal production systems taking into account the opinion of all stakeholders. Recently, SWOT has been used e.g. to compare chicken production systems in the Netherlands (Mollenhorst and de Boer, 2001), and to analyse innovations in Dutch horticulture and arable farming (Bremmer et al., 2000).

The conceptual model of the iguana production system was compared with other new production systems with non-traditional animal species to identify trends and trade-offs in the introduction and the development of new systems. Six key factors were identified, imporant for the introduction and development of new systems in terms of conditions, biology, support and market; and in terms of limitations, information, social conditions and legislation. If the key factors of the production systems are evaluated continuously during the development of the system, the system can be adapted. In the adapted system trends and trade-offs can take a more favourable turn and increase the possibility of successful development of the system. This approach of key factors for new production systems might also be used to study the introduction of biological farming in the Netherlands or introductions of new technologies in existing production systems.

Conclusions

Benefits of the soft systems approach in our case were:

1. A complete evaluation of the existing situation was carried out and this served as a suitable basis for the design of a conceptual model leading to adaptations of the existing iguana production systems.
2. The goals and opinions of all stakeholders were taken into account.
3. The exchange of ideas and experiences is not only a gain for the scientist (because farmers and local community have a better understanding of farming constraints, (Marsh, 1998)), but the stakeholders also profit from this exchange of experiences.

4. The workshops motivated the stakeholders to start solving problems by taking the initiative: they feel involved and are more willing to adopt the innovation (Marsh, 1998).
5. The process did not stop at the design of the production system, but this design was compared with other new production systems with non-traditional animal species.

Problems of the soft systems approach were:
1. The evaluation was labour-intensive and time-consuming.
2. The involvement of stakeholders from higher hierarchical levels (especially government officials) was difficult to ascertain.
3. The results obtained in using participatory methods are influenced by the participation of individual participants of different stakeholders and by the chairperson of the meetings.

Due to the labour intensity of the methods associated with the in-depth study of the systems, the soft systems approach can only be used for a limited number of farms. With the introduction of a new system, however, the number of adopters is small. It is inherent for a system being in an introductory phase that only a small number of farms can be visited. Thus, the soft system approach is a suitable method for assessing new productions systems.

Iguana production systems were still in their introductory phase. Consequently, only small numbers of farms and thus respondents were available for each group (iguana farmers, their neighbours, former iguana farmers) and the variability in responses made it difficult to establish statistically significant differences, but the observed differences might point to important conditions for successful introduction of iguana farming.

8.2 About the results

Prospects and constraints of the iguana production system

Social, technical, economic, ecological and legislative effects on iguana production

Prospects

All over the world, new production systems with non-traditional species have been and are being proposed and introduced as alternatives for existing agricultural production systems. The iguana production system is one example of such a system with non-traditional species. These new production systems with so-called microlivestock are proposed, because the initiators believe that these systems do not face the same constraints as the production systems with traditional species. For example, the systems do not need high investments, microlivestock does not need a lot of space, and the animals provide a protein source to improve the diet of resource-poor farmers (National

het succes van leguanenproductie waren: weinig nevenactiviteiten buiten het bedrijf, omdat leguanenhouderij tijdrovend was; coöperatieve bedrijven, die de toegang tot technische kennis vergrootten; beschikbaarheid van opleidingsmogelijkheden en krediet; en een hogere opleiding. Het houden van leguanen voor niet-commerciële doelen, het huisvesten van volwassen leguanen in meer natuurlijke systemen en het beter plannen van de activiteiten op het bedrijf bleken factoren die gekoppeld waren aan een groter succes met het houden van leguanen.

Van de leguanenhouderij werd verwacht dat het extra inkomsten zou opleveren voor de kleinschalige boeren, het natuurbehoud zou stimuleren, dierlijk eiwit zou produceren, en het aantal bomen en de kennis over de natuur zou doen toenemen. Een belangrijke beperking was de hoogte van de startinvestering, vooral omdat banken geen kredietprogramma's hebben voor dit soort activiteiten, waardoor kleinschalige boeren afhankelijk waren van kredietmogelijkheden verschaft door NROs. De bestaande leguanenbedrijfjes in Nicaragua en Panama hadden slechte vooruitzichten om extra inkomsten te genereren. Leguanenhouderij had ecologische voordelen: leguanenboeren hadden een positieve houding ten opzichte van natuurbehoud, leguanenhouderij beschermde bomen, vergrootte de kennis van boeren over de natuur en het gebruik van lokale voedermiddelen. Bestaande wetgeving en regulering van leguanenhouderij en leguanenhandel (waaronder de Conventie over de internationale handel in bedreigde wilde flora- en fauna-soorten [CITES]) beperkten de mogelijkheden om leguanen en hun producten te commercialiseren. Om leguanenhouderij succesvol te introduceren, moet het winstgevend zijn voor de boeren, en moeten deze boeren professionele hulp krijgen om te kunnen voldoen aan de wettelijke vereisten voor leguanenhouderij.

Bij het inventariseren van de visie van de boeren in Centraal Amerika met betrekking tot leguanenbedrijfjes als systemen is gebruik gemaakt van een visuele methode. Respondenten werd gevraagd om componenten toe te wijzen aan het bedrijf of de aan omgeving en om het belang van deze componenten aan te geven; de componenten werden gevisualiseerd in striptekeningen. De visies verschilden tussen landen en respondenten. De meeste respondenten noemden externe componenten, die werden geïnterpreteerd als componenten die de boer niet kan beïnvloeden, als belangrijk voor het al of niet slagen van de leguanenhouderij. De discussie over concepten op basis van deze visuele methode voorkwam een aantal mogelijke problemen tussen respondenten en de interviewer. Deze problemen zouden veroorzaakt kunnen worden door verschillen in sociale- en taalachtergrond tussen interviewer en respondent, door verschillende betekenissen van woorden in verschillende gebieden.

De karakterisering en analyse van leguanenproductie in Nicaragua, Costa Rica en Panama liet zien dat leguanenproductie een complex systeem vormt, waarbij diverse

belanghebbenden betrokken zijn. Om de problemen op te sporen en de conflicterende doelen van de verschillende belanghebbenden bijeen te brengen, is een "zachte" systeembenadering gebruikt. Het productiesysteem werd bediscussieerd met twee groepen belanghebbenden: de Boeren en de Organisaties. De groep Organisaties bestond uit vertegenwoordigers van de regering en van niet-regerings organisaties. De discussies van en met belanghebbenden leidden tot conceptuele modellen van het systeem. Deze modellen werden vervolgens gebruikt om de geïdentificeerde problemen te bespreken, mogelijke oplossingen te bedenken en de haalbaarheid van deze oplossingen in te schatten. Belanghebbenden noemden problemen gerelateerd aan de markt, aan kosten, omgeving, informatie, reproductie en wetgeving. Deze problemen verschilden niet van de problemen die naar voren waren gekomen tijdens de karakterisering van de bestaande leguanen productiesystemen. Voorgestelde oplossingen waren onder andere het aanbieden van voorstellen aan financiers, het oprichten van boerenorganisaties, het organiseren van cursussen en het uitwisselen van ervaringen.

De verschillende fasen in de ontwikkeling van leguanen productiesystemen in Centraal Amerika zijn vergeleken met ervaringen bij de ontwikkeling van andere nieuwe productiesystemen met niet-traditionele diersoorten. Experts op het gebied van nieuwe productiesystemen met niet-traditionele diersoorten (hierin zijn betrokken pacas, vicuñas, grasknagers, herten, bisons, paling, tilapia, meerval en struisvogels) zijn geïnterviewd over hun ervaringen tijdens de ontwikkeling van het systeem. De studie leverde 6 sleutelfactoren op die van belang zijn bij de introductie en ontwikkeling van nieuwe productiesystemen met niet-traditionele diersoorten. Deze factoren konden worden onderscheiden in *voorwaarden* waaraan voldaan moet worden om te starten met een nieuw productiesysteem: biologie, ondersteuning en markt; en *beperkingen* die de ontwikkeling van nieuwe productiesystemen kunnen belemmeren: informatie, sociale omstandigheden en wetgeving. Op basis van deze sleutelfactoren konden algemene trends en beperkingen in de verschillende fasen van de ontwikkeling van de systemen worden geïdentificeerd. De sleutelfactoren houden rekening met verschillen tussen diersoorten en landen en ze bepalen de ontwikkeling van een nieuw productiesysteem. Het vergelijken van de sleutelfactoren bij de verschillende productiesystemen stelde ons in staat om de mogelijkheden voor ontwikkeling van productiesystemen te verkennen en hun vooruitzichten en beperkingen te bepalen.

Door het bestuderen van de sleutelfactoren voor leguanenproductie in Panama werd de ontwikkeling van het systeem onderzocht en werden de meest belangrijke beperkingen geïdentificeerd. Alle sleutelfactoren waren negatief voor leguanenproductie. Dit was ook het geval voor pacas, vicuñas, bisons en struisvogels. De ontwikkeling van deze systemen gaf aan dat als de situatie met betrekking tot de voorwaarden, namelijk

biologie, ondersteuning en markt, niet zou veranderen, dan zou het aantal leguanenboeren zich stabiliseren of zelfs afnemen. Ondanks de vorming van boerencoöperaties en de uitwisseling van informatie en ervaringen tussen boeren, voorlichters en andere belanghebbenden zal de uitspreiding van de leguanenhouderij worden belemmerd door de niet-vervulde voorwaarden: geen markt voor leguanenproducten, geen ondersteuning en biologische problemen in de leguanenproductie.

Niet-regerings- en regerings-organisaties waren gestart met de introductie van leguanen productiesystemen in Nicaragua en Costa Rica, terwijl enkele vooruitstrevende boeren, ook wel vernieuwers genoemd, het systeem hadden toegepast in Panama. Dit heeft geleid tot een aantal teleurgestelde boeren en vele problemen omdat het systeem niet haalbaar bleek. Blijkbaar was het productiesysteem niet klaar voor een meer algemene toepassing. In Panama echter, wordt het systeem voortdurend aangepast door de vernieuwers en nu zijn daar ook verschillende andere boeren, zogenaamde vroege toepassers, begonnen (zonder ondersteuning van NROs, universiteiten of regeringen). Deze vroege toepassers voelen zich nog steeds belemmerd door het gebrek aan informatie, ongunstige sociale omstandigheden en wetgeving. Hier kunnen organisaties inspringen om de productie te stimuleren, bijv. door het veranderen van de wetgeving om de toepassing van het productiesysteem en de handel in leguanen te vergemakkelijken.

Resumen

Campesinos con pocos recursos en América Central usan pequeños animales silvestres como recurso de proteína. Otros recursos, como por ejemplo carne bovina, son demasiado caros. Un recurso de proteína tradicional en esta región es la iguana verde (*Iguana iguana*). Las iguanas han sido importantes como recurso alimenticio por mas de 7000 años. Las iguanas todavía son consumidas en todo su hábitat natural, desde los margines de los bosques tropicales de México hasta Paraguay. Recientemente, las iguanas son cazadas hasta casi extinción; la cuál también es asociada con la destrucción de su hábitat natural, p.e. deforestación.

Los sistemas de producción de iguanas pueden contribuir en el establecimiento de una situación balanceada, de acuerdo con los objetivos esperados: una situación económicamente viable para los campesinos, la conservación del bosque natural y la producción de la proteína animal; las cuales se pueden realizar simultáneamente. El establecimiento de nuevos bosques con objetivos múltiples en regiones agrícolas, provee productos forestales a los campesinos (leña, frutas, madera) y simultáneamente protege los suelos y los recursos de agua.

El objetivo de este estudio fue analizar los sistemas de producción de iguanas existentes en Nicaragua, Costa Rica y Panamá, como base para el diseño de un sistema de producción de iguanas integrado, tomando en cuenta los diversos objetivos de los gobiernos, las organizaciones no-gubernamentales (ONGs) y los usuarios próximos (p.e. campesinos) del sistema. El estudio tiene que dar expectativas y limitaciones para la crianza de iguanas y las implicaciones del sistema en su totalidad, incluyendo a los campesinos, el bosque natural y las iguanas.

Para caracterizar y analizar los sistemas de producción de iguanas existentes se usaron encuestas con campesinos criadores de iguanas y campesinos que ya no hacen esta actividad, sus vecinos, expertos de iguanas y administradores del gobierno. Se evaluaron los sistemas de producción de iguanas existentes y se identificaron las condiciones importantes para la crianza de iguanas. Los aspectos sociales que facilitaron la producción de iguanas fueron: pocas actividades fuera de la finca, porque la crianza de iguanas es una actividad que necesita mucho tiempo y esfuerzo; a través de fincas cooperativas se aumenta el acceso al conocimiento técnico; facilidades de educación y crédito; y educación de campesinos. Para reducir los efectos negativos es necesario tener iguanas con un objetivo no-comercial, mantener las iguanas adultas en un sistema natural y mejorar la planificación de las actividades de la finca.

Se estimo que la crianza de iguanas puede facilitar un ingreso adicional a los campesinos de pocos recursos, estimular la conservación de la naturaleza, producir la proteína animal, aumentar el numero de los arboles e incrementar el conocimiento de la naturaleza. Una limitación importante fue la inversión inicial, especialmente porque los bancos no proveen programas de crédito y los campesinos dependen de los esquemas de las ONGs. En Nicaragua y Panamá, los sistemas de producción de iguanas tenían malas expectativas para generar ingresos adicionales. Tener iguanas provee beneficios ecológicos: estimuló una actitud positiva para la conservación de la naturaleza, conservó arboles, aumentó el conocimiento de los campesinos y el uso de los recursos alimenticios locales. La legislación existente y las regulaciones de la crianza de iguanas y el comercio (incluido la Convención Internacional del Comercio de las especies amenazadas de la flora y fauna (CITES)) limitó las posibilidades de la comercialización de las iguanas y sus productos. Para introducir la crianza de las iguanas con éxito, tiene que ser remunerativo para los campesinos y es necesario que tengan apoyo profesional para cumplir con los requisitos estatutarios para la crianza de iguanas.

Para examinar las visiones de los campesinos de las fincas de iguanas como sistemas en América Central, se usó el método de la visualización. A los entrevistados se les pregunto si destinaban los componentes a la finca o al ambiente y para indicar la importancia de ellos. Los componentes fueron visualizados por dibujos de "cómic". Las visiones variaron entre los países y entrevistados. La mayoría de los entrevistados mencionaron los componentes externos, interpretados como no bajo el control de los campesinos, como factor importante para la crianza de las iguanas. La discusión de los conceptos basados en el método de visualización previno problemas entre los entrevistados y la entrevistadora causados por diferencias en los antecedentes socio-lingüísticos y porque las palabras tenían diferentes significados en diferentes regiones.

La caracterización y el análisis de la producción de las iguanas en Nicaragua, Costa Rica y Panamá enseñó que la producción de las iguanas consistía de un sistema complejo involucrando varios grupos interesados. Para identificar los problemas y resolver los objetivos contradictorios entre interesados, se uso un 'suave' enfoque de los sistemas. El sistema de producción fue discutido con dos grupos de interesados: Campesinos y Organizaciones. Organizaciones consistieron de funcionarios del gobierno y de los ONGs. Las discusiones con los interesados resultaron en modelos conceptuales del sistema. Estos modelos fueron usados para discutir problemas, posibles soluciones y la factibilidad de estas soluciones. Los interesados mencionaron problemas relacionados con el comercio, los costos, el medio ambiente, la información, reproducción y legislación. Estos problemas también fueron identificados durante la caracterización de los sistemas de producción de iguanas existentes. Las soluciones

sugeridas por campesinos que crían iguanas incluyeron la presentación de propuestas a financieros, la organización de campesinos criadores, la organización de cursos e el intercambio de experiencias.

Se comparó el desarrollo de los sistemas de producción de iguanas en América Central en sus diferentes fases de desarrollo con la introducción de otros nuevos sistemas de producción de especies animales no-tradicionales. Fueron entrevistados expertos de sistemas de producción de nuevas especies de animales no-tradicionales, como por ejemplo pacas, vicuñas, ratón de campo africano, ciervos, bisontes, anguilas, tilapia, bagre africano y avestruces, sobre sus experiencias con el desarrollo del sistema. El estudio ha revelado seis factores claves para la introducción y desarrollo de los nuevos sistemas de producción de especies animales no-tradicionales. Estos factores se pueden dividir en condiciones que se necesitan para empezar un sistema de producción nuevo: biología, respaldo y comercio; y en limitaciones que pueden obstruir el desarrollo de los sistemas de producción nuevos: información, condiciones sociales y legislación. Fueron identificados tendencias generales y intercambios, basado en estos factores claves en diferentes fases del desarrollo de los sistemas. Los factores claves tuvieron en cuenta las diferencias entre especies y países y determinaron el desarrollo de un sistema de producción nuevo. La comparación de factores claves entre sistemas de producción permitió explorar el margen del desarrollo de los sistemas de producción y sus perspectivas y limitaciones.

El estudio de los factores claves para la producción de iguanas en Panamá exploró el desarrollo del sistema e identificó sus limitaciones más importantes. Todos los factores claves aparecieron negativos para la producción de iguanas. Esto fue igual para las pacas, vicuñas, bisontes y avestruces. El desarrollo de estos sistemas indicó que si las condiciones, p.e. biología, respaldo y comercio, no hubieran cambiado, la dispersión de la producción de las iguanas podría mantener estable o incluso bajar. La dispersión del sistema de producción podría ser restringido por las condiciones de la falta de las oportunidades del comercio de productos de la iguana, falta de respaldo y problemas biológicos en la producción de iguanas, a pesar de la formación de una asociación de los campesinos y el intercambio de la información y experiencias entre campesinos, asesores y otros interesados.

Las organizaciones no-gubernamentales y del gobierno empezaron a introducir sistemas de producción de iguanas en Nicaragua y Costa Rica, mientras solo algunos campesinos innovadores habían adoptado el sistema en Panamá. Eso ha resultado en un numero de campesinos desilusionados y muchos problemas porque el sistema no pareció factible. Evidentemente, el sistema de producción no estaba listo para una adopción general. En Panamá, sin embargo, el sistema continuó siendo adaptado por innovadores y ahora

8a. ¿Cómo es su educación?

***ENQ.**: ¿Cuál es la enseñanza más alta que ha seguido? ¿Ha terminado esta enseñanza?*

8b. ¿Cómo es la educación de sus miembros de la familia que colaboran en el trabajo en la finca?

entrevistado

	Escuela, enseñanza	terminado	cursando	dejado
1		1	2	3
2		1	2	3

miembro de la familia colaborando:

	Escuela, enseñanza	terminado	cursando	dejado
1		1	2	3
2		1	2	3

miembro de la familia colaborando:

	Escuela, enseñanza	terminado	cursando	dejado
1		1	2	3
2		1	2	3

miembro de la familia colaborando:

	Escuela, enseñanza	terminado	cursando	dejado
1		1	2	3
2		1	2	3

Las siguientes preguntas tratan de las capacitaciones/cursos/talleres que Usted eventualmente ha seguido.

9. ¿Usted ha seguido cursos durante su carrera / ser adulto?

Sí (sigue con pregunta 10)

No (sigue con pregunta 12)

10. Qué son los cursos que Usted ha seguido?

Nombre del curso	terminado si / no	tiempo año / mes / día

***ENQ.**: si uno de estos cursos es sobre la crianza de las iguanas, sigue con pregunta 11, si no sigue con pregunta 12.*

11. Usted habló sobre un curso de la crianza de las iguanas. ¿Porqué ha seguido esto curso?

***ENQ.**; pregunta:*

- ¿Qué ventaja tenía el seguir de esto curso por Usted?

- ¿Qué ha aprendido Usted del curso?

- ¿El curso ha satisfecha sus esperanzas?

8a. What is your education?

***Int.**: What is the highest education level you have attended? Did you complete these classes?*

8b. What is the education level of the members of your family that co-operate in on-farm work?

respondent

	School, education	completed	attending	stopped
1		1	2	3
2		1	2	3

Member of the family co-operating:

	School, education	completed	attending	stopped
1		1	2	3
2		1	2	3

Member of the family co-operating:

	School, education	completed	attending	stopped
1		1	2	3
2		1	2	3

Member of the family co-operating:

	School, education	completed	attending	stopped
1		1	2	3
2		1	2	3

The following questions deal with the courses/workshops you possibly attended.

9. Did you attend courses during your career/your adult life?

Yes (continue with question 10)

No (continue with question 12)

10. What courses did you attend?

Name of the course	completed yes / no	time year/month/day

***Int.**: If one of the courses is about keeping iguanas, continue with question 11, if not continue with question 12.*

11. In the last answer, you referred to a course in iguana keeping. Why did you follow this course?

***Int.**: ask:*

- *What advantage had attending this course for you?*
- *What did you learn during the course?*
- *Did the course meet your expectations?*

23. ¿Usted puede decir cuales dibujos son importantes (el mas importante primero)?

***ENQ.**: anota por lo menos seis (1-6)*

numero	Orden	numero	Orden
1 finquero / mandado		15 comerciante de los alimentos	
2 finquera		16 trabajo fuera de finca (casa)	
3 hijos		17 vecinos	
4 iguanas verdes		18 finca de cría	
5 corral		19 pueblo	
6 árboles		20 extensionista	
7 lluvia		21 gobierno	
8 animal de presa		22 veterinario	
9 turistas		23 comerciante	
10 consumidor		24 sol	
11 monte a los caminos		25 cosecha	
12 frutas		26 ganado	
13 huerto		27 dueño	
14 bosque natural		28	

***ENQ.**: pregunta de control: ¿Los dibujos restantes no afectan la finca, ni pertenecen a la finca?*

24. ¿Cuando Usted mira a la finca, que Usted ha puesto en el papel, me puede decir si su finca esta afectado por cosas o si su finca persigue objetivos, que ya no ha mencionado?

objetivos/cosas orden

25. ¿Usted puede poner estas cosas/objetivos en orden de la importancia?

***ENQ.**: apunta en pregunta 24.*

26. ¿Qué condiciones tiene que satisfacer para lograr los objetivos denominados?

***ENQ.**: preguntar: ¿Cómo tiene que ser acondicionado la finca (estado del sistema de producción) y cuales condiciones tiene que satisfacer (asuntos que afectan la finca de fuera)?*

condiciones *(vea también pregunta 22)*

.....

condición de la finca *(vea también pregunta 20)*

.....

Las próximas preguntas tratan de comercio en iguanas y huevos de iguanas.

Iguanas

27. ¿Cuántas veces ha comprado/ha recibido iguanas en los tres años pasados?

28. ¿Cuántas iguanas compro/recibo por cada vez?

***ENQ.**: denominar los números de los tres años pasados*

fecha (aproximado) numero precio del Iguana

.....

29. ¿Qué fue el precio por iguana, que Usted tenía que pagar?

***ENQ.** : apuntar en pregunta 28.*

30. ¿Qué edad tenían las iguanas cuando Usted las recibió?

***ENQ.** :edad en promedio preñadas: si/no*

23. Can you indicate which drawings are important to the environment (the most important first)?
Int.: monitor at least six (1-6)

number	order	number	order
1 farmer/manager		15 feed merchant	
2 farmer's wife		16 off-farm job	
3 children		17 neighbours	
4 iguanas		18 breeding farm	
5 compound		19 village	
6 trees		20 advisor	
7 rain		21 government	
8 predators		22 veterinarian	
9 tourists		23 merchant of iguanas	
10 consumer		24 sun	
11 woods-at-roadsides		25 harvest	
12 fruits		26 farm animals	
13 kitchen garden		27 proprietor	
14 natural forest		28	

Int.: Check: The drawings that remain do not affect the farm, and are not part of the farm?

24. When you look at the farm, that you have constructed with the drawings, do you notice objectives of your farm, or components affecting it that have not yet been mentioned?
objectives/components order

25. Can you give the order of importance of the objectives?
Int.: indicate in answer to question 24.

26. Which conditions have to be met to realise the identified objectives?
Int.: ask: How should the farm be equiped (state of the production system) and which conditions have to be met (components that affect the farm from outside)?
conditions *(see also question 22)*
.....
conditions at the farm *(see also question 20)*
.....

The following questions refer to the trade in iguanas and iguana eggs
Iguanas
27. How many times did you buy/receive iguanas in the past three years?

28. How many iguanas did you buy/receive each time?
Int.: give the numbers of iguanas of the last three years
date (approximate) number price per iguana
.....

29. What was the price per iguana that you had to pay?
Int.: indicate in answer to question 28.

30. What was the age of the iguanas when you received them?
Int.: mean age with eggs: yes/no

52. ¿En qué época del año Usted les da los alimentos mencionados en la pregunta anterior?

producto	meses	clase de edad
	e -f -m -a –m -j -j -a -s -o -n –d	

53. ¿A qué clase de edad de iguanas Usted da los alimentos?

ENQ. *: pregunta de control: apunta en pregunta 52.*

54a. ¿Hay árboles disponibles en la finca por las iguanas?

ENQ.*: ¿Hay árboles en las jaulas de las iguanas, en el corral?*

Cuando sí:

¿Porqué hay arboles en la jaula/afuera la jaula?

¿Qué tipo de árboles?

¿Cuántos árboles de cada tipo? (estimación)

¿Había árboles presentes, o había plantados especial por las iguanas?

¿Los árboles tienen otro objetivo que las iguanas?

tipo de árbol	# árboles	presente	plantado	objetivo de los árboles

54b. Otros objetivos denominados en la pregunta anterior:

¿Cuántos productos, que los árboles producen en un año se venden?

¿Qué fue el precio por producto vendido?

producto cantidad vendido por año precio por producto

- leña .....
- madera .....
- frutas, o sea .....
- diferente, o sea .....

55a. ¿Cuántos nidos tiene Usted? .... nidos

55b. ¿De qué material son construido?

.....

55c. ¿Cuánto cuesta el material por nido/un nido? ..... precio por nido

56a. ¿Cuántos termos tiene Usted? ..... termos

56b. ¿De qué material son construido?

.....

56c. ¿Cuánto cuesta el material por termo/un termo? ..... precio por termos

57a. ¿Cuántos red tiene Usted? ..... red

57b. ¿De qué material son construido?

.....

57c. ¿Cuánto cuesta un red? ..... precio por red

58. Otros factores denominados en pregunta 47:

¿Cuánto de producto ..... necesita por año?

¿Cuánto vale el producto?

producto cantidad por año precio por producto

.....

52. In what time of the year do you feed the iguanas with feeds mentioned in the previous question?

product	month	age class
	J – F – M – A – M – J – J – A – S – O – N – D	

53. Which age classes are given the iguana feed?

***Int.**: Check: indicate in answer to question 52.*

54a. Are trees available on farm for the iguanas?

***Int.**: Are trees present in the iguana cages/on the compound?*

if the answer is yes:

What kind of trees?

How many trees of each species? (estimate)

Were these trees present or were they planted especially for the iguanas?

Do the trees have other objectives than iguanas?

tree species	# of trees	present	planted	objective of trees

54b. Other objectives mentioned in preceding question:

What products of the trees are sold in one year?

What was the price per unit product?

product quantity sold per year price of product

- firewood
- timber
- fruits, such as
- other, viz.

55a. How many nests do you have? .... nests

55b. Of what material are they made?

.....

55c. What is the price of the material for each nest? ..... price per nest

56a. How many incubators do you have? ..... incubators

56b. Of what material are they made?

.....

56c. What is the price of the material for each incubator? ..... price per incubator

57a. How many nets do you have? ..... net

57b. Of what material are they made?

.....

57c. What is the price of the material for each net? ..... price per net

58.Other factors mentioned in question 43:

How much of product ..... do you need each year?

What is the price of the product?

product quantity per year costs per year

.....

Convivir con Iguanas

Elaborado por: Inga. C.H.A.M. Eilers y Lic. F. Esquivel
Junio 2000

Iguana Verde en el zoocriadero en Las Mariitas, Chinandega. *Foto: Karen Eilers*

Estudio de producción de iguana verde

La mayor producción de iguana verde se encuentra en los dos departamentos de occidente de Nicaragua: León y Chinandega. En esta zona se encuentra también la mayor población de iguanas en la naturaleza. Cerca su habitat natural empezaron proyectos de ONG's a estimular a pequeños productores en conservar la naturaleza y producir iguana verde en su patio en un encierro. En el año 2000 la mayoría de los proyectos de ONG's terminaron y los pequeños productores trabajan solo sin ayuda.

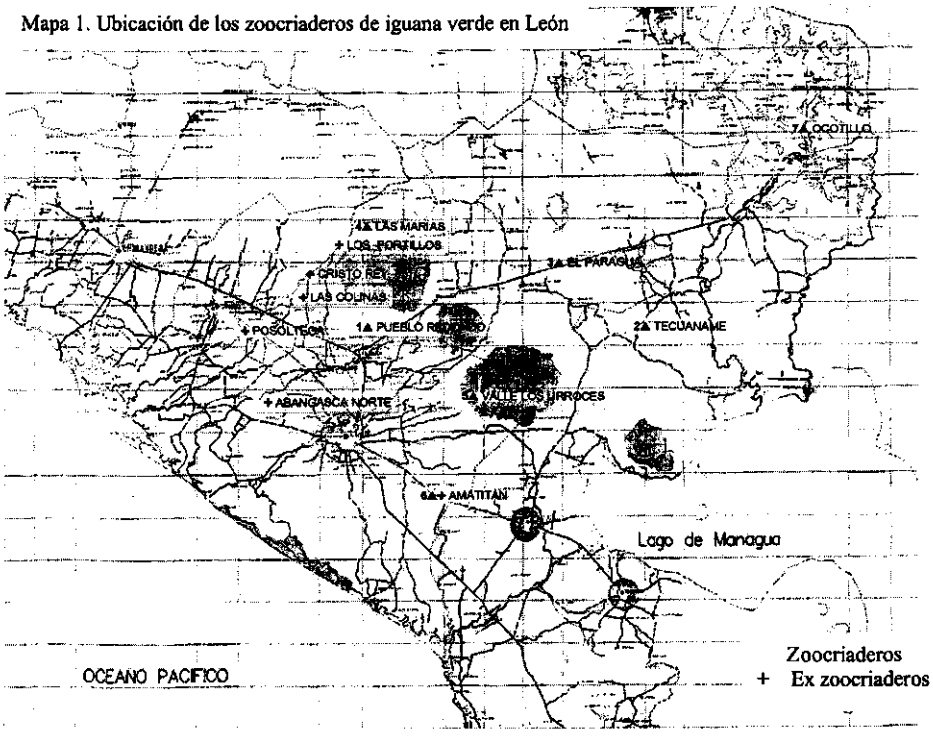
El objetivo de este estudio es de investigar la situación actual de los zoocriaderos de iguana verde de los pequeños productores de León y Chinandega. En Marzo y Abril 2000 visitamos los criaderos con el propósito de realizar una entrevista para obtener los datos sobre la situación actual. Los productores y los lideres comarcales fueron convocados a dos reuniones con el objetivo de compartir la experiencia e intercambiar ideas y obtener las fortalezas y problemas de la producción de la iguana en la zona. Así pudimos obtener una vista general del sistema de producción y formular cuales son los problemas mas importante y como se pueden solucionar.

Involucramos en el estudio a las ONG's, gobiernos municipales y delegaciones departamentales del MARENA (León – Chinandega) para analizar si las solucionas propuestas por los productores son viables y estas puedan fortalecer el sistema de producción de iguanas. Con el mismo objetivo discutimos los resultados con las autoridades de exportación y de la biodiversidad.

La situación actual

En el departamento de León existen 7 criaderos de iguana verde; (Pueblo Redondo, Valle los Urroces, El Paragua, Tecuaname, Las Marias, Ocotillo y Amatitan (Mapa 1)). Seis criaderos de iguana verde culminaron la actividad; (Los Portillos, Cristo Rey, Las Colinas, Posoltega, Abangasca Norte y Amatitan). La causa mas importante de la culminación fue la baja producción debido por el desconocimiento, poca capacitación, poca dedicación y el inicio con juveniles.

Mapa 1. Ubicación de los zoocriaderos de iguana verde en León



Mapa 2. Ubicación de los zoocriaderos de iguana verde de Chinandega

En el departamento de Chinandega existen 4 criaderos de iguana verde; (Las Mariitas, St. Tomas del Norte, Cabo de Horno y Cosiguïna (Mapa 2)). Cinco criaderos de iguana verde culminaron la actividad; (Somotillo, Alemania Federal, Luis Andino, Cabo de Horno y El Realejo). La causa mas importante de la terminación en Chinandega fue la imposibilidad de vender las iguanas. "No pudimos vender en el tiempo mas adecuado a un precio rentable" fue lo que expresaron los exproductores. En el cuadro 1 esta escrito la situación actual de los criaderos de iguana verde de León y Chinandega. Muchos proyectos empezaron la producción de iguanas como un componente con el propósito de repoblar y proteger a la especie. El objetivo cambia con el tiempo, ganando experiencia y al culminar la ayuda de las ONG's, los productores quieren un ingreso por el trabajo que hacen.

Cuadro 1. Situación actual de los criaderos de León y Chinandega

Productores de León	Inicia	Objetivo actual	Producción	Comercialización
Telica	'94	Ingreso	alta	varias veces
Tecuaname	'96	Protección	media	una vez
Paragua + Ter.	'96	Ingreso	baja	no
Las Marias	'98	Ingreso	baja	no
Valle Los Urroces	'94	Ingreso	baja	una vez
Amatitan	'98	Repoblar	nada	no
Ocotillo	'00	Alimentación	baja	no
Productores de Chinandega				
St. Tomas del Norte	'94	Ingreso	alta	dos veces
Las Mariitas	'97	Ingreso	media	dos veces
Cosiguïna	'96	Educación	baja	no
Cabo de Horno	'92	Ingreso	baja	una vez
Mata de Cocoa	'97	Repoblar	media	no
Exproductores de León				
Cristo Rey	'96	Alimentación	baja	no
Los Portillos	'96	Ingreso	no	no
Posoltega	'98	Ingreso	no	no
Las Colinas	'94	Repoblar	baja	no
Amatitan	'98	Repoblar	no	no
Abangasca Norte	'97	Ingreso	media	una vez
Exproductores de Chinandega				
Luis Andino, Tonala	'95	Ingreso	alta	dos veces
Alemania Federal	'95	Ingreso	alta	varias veces
Cabo de Horno	'92	Ingreso	media	una vez
Somotillo	'96	Ingreso	alta	dos veces
El Realejo	'99	Repoblación	no	no

Descripción y ubicación de los zoocriaderos en León:

Telica, Pueblo Redondo (Mapa 1, # 1):
Productor: Emilio Martinez, quien trabaja con 2 socios activos del zoocriadero. Este productor es tambien lider de la comunidad. El tiene con sus socios 6 años de experiencia. La producción de las iguanas es una actividad principal de su finca.
de Hembras: 300
Producción Futura: 3090
Problema mas importante: la comercialización

Tecuaname (Mapa 1, # 2):
Productor: Genaro Andino, quien trabaja solo en el zoocriadero con colaboración de su familia. El tiene 4 años de experiencia. La producción de las iguanas es una actividad adicional de su finca. La siembra de los granos básicos es la actividad principal.

de Hembras: 200
Producción Futura: 2112
Problema mas importante: la comercialización

Paragua y Terreros 3 (Mapa 1, # 3):
Productores: Secundino Calero y Silvia Ramirez, quienes juntaron las iguanas en 1999 y el primer productor cuida las iguanas. La producción de las iguanas es una actividad adicional de su finca. La producción de la leche es la actividad principal. Ellos tienen 4 años de experiencia en la producción de iguanas.
de Hembras: 50
Producción Futura: 180
Problema mas importante: la sobrevivencia de las juveniles

Las Marias (Mapa 1, # 4):
Productor: Alvaro Espinoza, quien trabaja solo en el zoocriadero con la colaboración de una señora. La producción de las iguanas es una actividad adicional de su finca. La producción del ganado es la actividad principal. El tiene 2 años de experiencia
de Hembras: ?
Producción Futura: 100
Problema mas importante: poca experiencia

Valle los Urroces (Mapa 1, # 5):
Productor: Joaquin Vargas, quien trabaja solo en el zoocriadero con la colaboración de su familia. La producción de las iguanas es una actividad adicional de su finca. La forestación es la actividad principal de su finca. El tiene 6 años de experiencia.
de Hembras: 110
Producción Futura: 220
Problema mas importante: la comercialización y la desmotivación por la perdida que causo el Mitch

Amatitan (Mapa 1, # 6):
Productor: ? , y su esposa cuida las iguanas en el zoocriadero. La producción de las iguanas es una actividad adicional. El trabaja como administrador de otra finca es la actividad principal del productor. El tiene 2 años de experiencia.
de Hembras: ?
Producción Futura: 0
Problema mas importante: perdida de huevos.

Ocotillo (Mapa 1, # 7):
Productor: Dimaz Rodrigues, quien trabajo solo con ayuda de su familia en el zoocriadero. La producción de las iguanas es una actividad adicional de su finca. La actividad principal es la producción del ganado. El tiene 3 meses de experiencia con la producción de las iguanas.
de Hembras: 8
Producción Futura: 90
Problema mas importante: poca experiencia y no hay divisiones en su jaula.

Descripción y ubicación de los zoocriaderos en Chinandega:
St. Tomas del Norte (Mapa 2, # 1):
Productores: Santo Varela y Francisco Varela, quienes trabajan en el zoocriadero con la colaboración de 1 persona. La producción de las iguanas es una actividad adicional del productor principal. La actividad principal es transportista. El tiene 6 años de experiencia.
de Hembras: 180
Producción Futura: 4374
Problema mas importante: la comercialización

Las Mariitas (Mapa 2, # 2):

Dueño: IBRA, técnico es Donald Pedro, quien trabaja como docente en el Instituto y tiene la colaboración de un cuidador, profesores y estudiantes. La producción de las iguanas es una actividad adicional del Instituto. La actividad principal es la educación de los estudiantes. El técnico tiene 3 años de experiencia.
de Hembras: 155
Producción Futura: 1500
Problema mas importante: la sobrevivencia de los juveniles y la comercialización

Cosiguina (Mapa 2, # 3):
Productor: Gonzalo Nuriez quien trabaja solo como cuidador en el criadero de las iguanas de la escuela de Cosiguina. La producción de las iguanas es una actividad adicional de la escuela. La actividad principal del cuidador es la producción de los granos básicos. El tiene 4 años de experiencia.
de Hembras: 40
Producción Futura: 90
Problema mas importante: la sobrevivencia de los juveniles y poco conocimiento

Cabo de Horno (Mapa 2, # 4):
Productor: Facundino Lopes quien trabaja juntos con su esposa en el criadero de las iguanas. La producción de las iguanas es una actividad adicional en su finca. La actividad principal es la producción del ganado. El tiene 8 años de experiencia, pero con su propio criadero solo 3 años.
de Hembras: 16
Producción Futura: 160
Problema mas importante: la sobrevivencia de los juveniles y la comercialización

Mata de Cocoa (Mapa 2, # 5):
Productor: Marvin Narvaes, quien trabaja con dos socios en el zoocriadero. Ellos tienen 3 años de experiencia.
de Hembras: 75
Producción Futura: 1125
Problema mas importante: la comercialización

Causas de los problemas

Los problemas principales de los zoocriaderos son causados por diferente factores; la ubicación de los zoocriaderos, la educación de los productores, la ganancia por semana y la división del trabajo entre todas las actividades.

Ubicación de los zoocriaderos
En figura 1 esta reflejada la distancia en minutos de los zoocriaderos hasta las ONG's.

El promedio de la distancia es 71 minutos, mas de una hora para llegar a la oficina de las ONG's, donde se puede obtener asistencia técnica ó crédito. La distancia hasta la finca y los gastos de la transportación, que lo haces difícil de obtener asistencia técnica en la hora mas necesaria.

Educación de los productores
La educación de los productores varia mucho entre los diferentes productores: hay productores quienes no saben escribir y productores quienes terminaron la universidad (Figura 2). La educación influye la facilidad de hacer los tramites y de leer y entender la información sobre la producción.

Figura 1. Distancia de los criaderos hasta las ONG's en minutos.

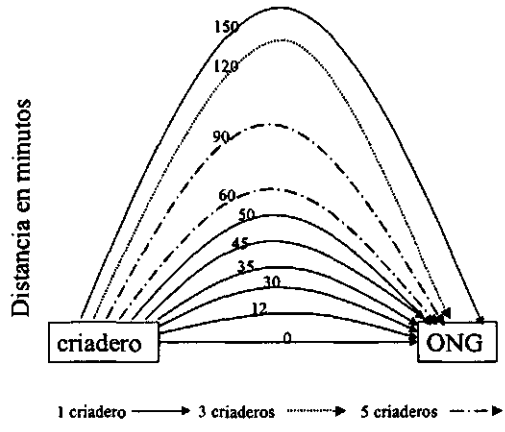
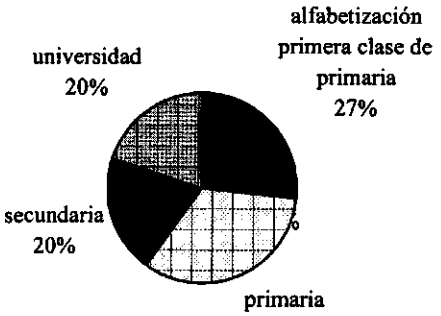


Figura 2: Educación de los productores



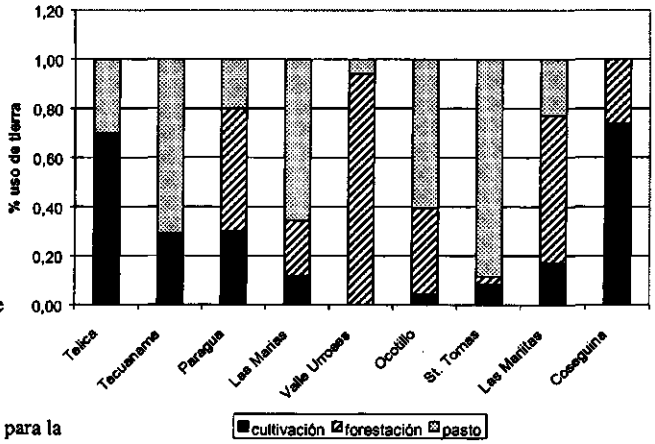
Ganancia por semana

La población interrogada gana un promedio de US$33 por semana, con un mínimo de US$0 y un máximo de US$220. La ganancia es para sobrevivir, pero no es suficiente de ahorrar para una inversión inicial de un criadero. Las interrogadas viven en comarcas con un promedio de 741 habitantes, con un mínimo de 210 habitantes y un máximo de 1500 habitantes. 67% de la población interrogada es miembro de una organización. La mayoría de estas organizaciones son organizaciones de los agricultores.

Uso de la tierra

Las fincas tienen una extensión de 62 manzanas en promedio, con un mínimo de 0.1 manzana y un máximo de 610 manzanas. El estado actual de la tierra para la agricultura según los interrogados es reflejado en el cuadro 2. La mayoría de los interrogados mencionó que con el huracán Mitch parte de su tierra fue afectada.

Figura 3. Uso de la tierra en las fincas de los productores



Cuadro 2. Estado actual de la tierra para la agricultura.

Estado	% mencionado
bueno	20
regular	35
malo	45

La mayoria de la gente (75%) indica que todos sus tierras son propias, el 15% tiene un parte en su propiedad, y el 10% de los interrogados no tiene tierra propia.

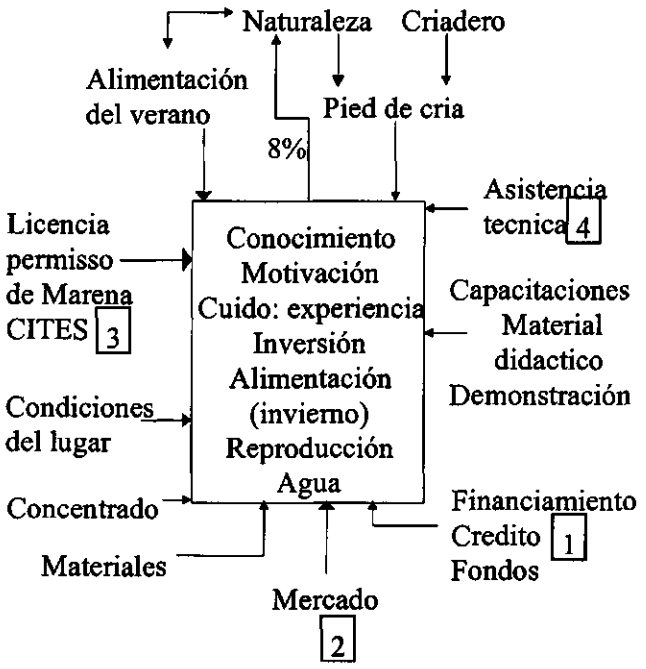
En figura 3 esta reflejada el uso de la tierra en las fincas de los productores. En la tierra cultivada se siembran maíz, ajonjolí, sorgo, frijoles, yuca y platanos y hortaliza como por ejemplo tomate, chitomo y sandia. La mayoría de la tierra forestal esta plantada con eucalipto, nin y madero negro. Los pastos existen de pasto natural y pasto mejorado como jamba y jaragua.

Este uso de la tierra refleja las otras actividades a que se dedican los productores. Especialmente durante el período de crecimiento de los juveniles, las actividades competen con la siembra de los granos básicos.

Resultados de las reuniones

Durante las discusiones de las reuniones se formó el siguiente modelo conceptual de la producción de iguanas (Figura 4). El objetivo de la producción es la comercialización de los juveniles.

Figura 4. Modelo conceptual.



Los problemas mas importantes de la producción de iguanas están indicados en la figura 4 con números. Buscar financiamiento por esta producción es difícil, porque no esta dentro los sectores de financiamiento de los bancos. 40% de los productores ha tenido crédito para la inversión inicial de las cooperativas y de las ONG's. De la población entrevistada el 95% ha tenido crédito anteriormente para la agricultura, aunque la mayoría dijó que este crédito fue hace muchos años. Los bancos piden una garantía (la finca), cuando se solicita un préstamo y los productores no quieren correr el riesgo de perder su finca. Además los intereses son bien altos (variando entre 8% y 20%), entonces solo el 19% de los interrogados mencionó que van a buscar crédito con un banco ahora.

Conclusiones y Discusión

La producción de la iguana es un ruro nuevo y desconocido por mucha gente. Esta situación lo hace mas difícil de buscar fondos, de encontrar expertas y material didáctico. Por el desconocimiento de la producción y los rumores sobre el fracaso de la producción no hay apoyo financiero. Para resolver los principales problemas los productores están formando una asociación para promover la producción y divulgar la actividad y sus efectos positivos (con el ejemplo de la asociación de acopiadores de la fauna silvestre quienes con su asociación formaron un poder). Con la asociación de los productores ellos pueden negociar con los

Falta de mercado en la hora mas adecuada con precios rentables es el siguiente problema: Los productores han logrado en vender el 49% de su producción a un precio pro medio de US$1.31 por iguana en el año 1997 (en total vendieron 5 productores), 43% de su producción a US$1.40 en el año 1998 (total 4 productores) y el 80% de su producción a US$1.28 en el año 1999 (total 4 productores). Otros problemas mencionados fueron poca asistencia técnica, dificultades de obtener el permiso de producir iguanas y la licencia de comercialización, y falta de material didáctico.

Los ONG's, gobiernos municipales y delegaciones de MARENA mencionaron mas factores. Los mas importantes fueron otros productos de la producción de iguanas: artesanía, atracción turística, producto medicinal, venta de material didáctico y alternativa alimenticia para la familia (52% de la población interrogada ha tenido crédito para alimentación familiar; 8 de una pulpería, 2 de amigos y 1 de un banco).

A pesar de todos los problemas podemos probar que la producción de las iguanas es viable y rentable. En cuadro 2 esta descrito la administración de la situación actual de cuatro zoocriaderos. No esta tomado en cuenta la inversión inicial, porque en caso 1 y 3 la inversión es una donación, en casos 2 y 4 la deuda ya esta pagado. Los zoocriaderos con los mejores resultados tienen muchos años de experiencia.

empresarios y el gobierno, porque no tenemos que olvidar que con su producción están protegiendo la iguana de la naturaleza, evitando que se extinga.

Cuadro 2. La administración de cuatro zoocriaderos

	Santo Tomas	Pueblo Redondo	Las Mariitas	St. Rosa de Peñon
producción:				
# hembras	180	300	125	8
producción futura	4374	3090	1500	90
8% a la naturaleza	350	247	120	7
pied de cria	656	150	180	83
precio promedio	US$1.5	US$1.5	US$1.5	-
ingreso futuro en cordoba	63.150	50.487	22.500	0
costos de producción por año:				
alimentación	6.900	17.600	1.953	1.200
desparasitación	120	500	230	45
padrotes	0	0	0	0
otros materiales	300	100	6.312	3.000
mano de obra	10.950	2.100	8.400	-
Total	18.270	20.300	16.895	4.245
ganancia futura	44.880	30.187	5.605	- 4.245
amplificación del criadero:				
# modulos	2	0 (37 termos)	2	2
juveniles/adultos	juveniles	incubación	adultos	adulto/juveniles
costos total	9.392	4.900	6.663	10.465
% de la ganancia	21%	16%	119%	-

Incubdoras de los huevos de iguanas *Foto: Karen Eilers*

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Annex 3

Farming chickens of the trees in my compound

C.H.A.M. Eilers, V. Ríos and A.C. González

Published to inform stakeholders of iguana production in Panama, August 2000

Abstract

In Panama, the major iguana production is found in three provinces: Herrera, Los Santos and Coclé. Traditionally, in these provinces iguana meat is considered a delicacy and consumed frequently. Because of the hunting and destruction of the habitat, iguanas are almost extinct. In 1983, the Smithsonian Tropical Research Institute started iguana production and in 1985, on-farm research started and the foundation Pro Iguana Verde was established. Following the example of the foundation, several farmers started in the three provinces. In 1991, an association of iguana farmers was established in Coclé. At present, 120 iguana farmers are found in these three provinces in Panama. These farms are divided in five types with different production goals: (1) communal farm with conservation as goal; (2) private farm, with iguanas for hobby and conservation; (3) commercial farm, with the goal to sell iguana products; (4) farm of association, owner organised himself with others to conserve the species and to commercialise it; (5) farm with an educational goal. The problems mentioned by the farmers were high investments, high production costs (labour, feed and material), difficult to obtain a permit, lack of awareness of the community, theft, lack of knowledge about the reproduction, lack of technical assistance and communication among farmers, lack of knowledge about the market and market for parent animals is saturating fast. Although the production of iguanas started in Panama, it is still not recognised as a profitable activity, thus obtaining credit is a problem. NGOs are supporting iguana farming, but it remains difficult of find advisors or educational material about iguana production. The lack of communication among farmers is partly solved by the establishment of the association, which take the exchange of experiences up as an item on their agenda. Problems with the permits are dealt with by simplifying the rules and educating the governmental advisors.

Criando gallina de palo en mi patio

Elaborado por: C.H.A.M. (Karen) Eilers, Virginia Ríos y Augusto C. González
Agosto 2000

Figura 1. Juveniles de Iguana Verde en Llano Grande de Ocú, Herrera. *Foto: Karen Eilers*

Estudio de producción de iguana verde

En 1997 Karen Eilers hizo un estudio piloto de los sistemas de producción de las iguanas en tres países, Nicaragua, Costa Rica y Panamá. En el año 2000 ella regresó para ver el desarrollo de la producción de las iguanas y para conocer la situación actual de los criaderos y obtener las fortalezas y los problemas de la producción de la iguana verde.

En Panamá hay tres provincias donde se encuentra la mayor producción de iguana verde: Herrera, Los Santos y Coclé. Tradicionalmente en estas tres provincias la carne de la iguana es considerada una delicia y consumida frecuentemente. Cazando las iguanas para el consumo y destruyendo su habitat tumbando arboles son las razones por cuales ahora las iguanas están en vía de extinción. En 1983 la producción de la iguana verde en cautiverio fue iniciado por la doctora Dagmar Werner del Instituto Smithsonian de Investigaciones Tropicales (STRI). Ella inicio el Proyecto de Reproducción y Manejo Comunitario de la Iguana de la Fundación Pro Iguana Verde en Cabuya de Antón, en la provincia de Coclé en el año 1985. En el año 1989 el proyecto se traslado a Llano Grande de Ocú . En el año 1998 se termino la ayuda financiera de los donantes quedando un grupo de 6 criaderos de la fundación trabajando por cuenta propia.

Tomando el ejemplo del Proyecto de la Fundación en Llano Grande de Ocú y consiguiendo pie de cría con este criadero empezaron muchos criaderos en Herrera, Los Santos y Coclé. En el año 1991 se fundó la Asociación de Criadores de Iguana Verde y Animales Silvestres en Extinción (ASCIASE) en Penonomé, Coclé. Ahora se encuentran en las tres provincias 120 criaderos de iguana verde.

El objetivo de este estudio es de investigar la situación actual de los zoocriaderos de iguana verde en las tres provincias de Panamá (Herrera,

Figura 2. Mapa de los criaderos de Herrera

Leyenda

———	Carretera Principal
———	Carretera Secundaria
★	Cabecera de Provincia
■	Cabecera de Distrito
●	Otras Poblaciones
- - -	Limites Provincial
2	Criadero privado
3	Criadero comercial
4	Criadero de asociación
5	Criadero de educación

Figura 3. Mapa de los criaderos en Los Santos

Leyenda

———	Carretera Principal
———	Carretera Secundaria
★	Cabecera de Provincia
■	Cabecera de Distrito
●	Otras Poblaciones
— — —	Limites Provincial
1	Criadero Comunitario
2	Criadero Privado
5	Criadero de Educación

Los Santos y Coclé). En los meses Junio y Julio del 2000 visitamos los criaderos con el propósito de realizar una entrevista para obtener los datos sobre la situación actual. Los productores fueron convocados a dos reuniones con el objetivo de compartir la experiencia e intercambiar ideas y obtener las fortalezas y los problemas de la producción de la iguana verde en la zona. Así pudimos obtener una vista general del sistema de producción y formular cuales son los problemas mas importante y como se pueden solucionar.

Involucramos en el estudio a las organizaciones no gubernamentales, como Fundación Natura, Asociación Nacional para la Conservación de la Naturaleza (ANCON), Fundación Panama, Dobo Yala, los ministerios la Autoridad Nacional del Ambiente (ANAM) y el Ministerio de Desarrollo Agropecuario (MIDA) e instituciones privadas, como la Universidad Santa Maria la Antigua (USMA) y STRI, que tienen interés en la producción de las iguanas, para analizar si las soluciones propuestas por los productores son viables y si estas pueden fortalecer el sistema de producción de iguanas.

La situación actual

En Panamá se puede distinguir 5 tipos de criaderos, que tienen diferentes objetivos: (1) criadero comunitario con el objetivo de conservación de la especie, (2) criadero privado, que tiene iguanas por entretenimiento y conservación de la especie, (3) criadero comercial, con el objetivo de vender productos y subproductos de las iguanas, (4) criadero de asociación o fundación, donde el dueño se organizó con otros con el objetivo de conservar la especie y comercializarla, y (5) criadero con el objetivo de educación. En la provincia de Herrera; existen 17 criaderos de iguana verde y en la provincia de Los Santos; existen 41 criaderos de iguana verde (Figura 2 y 3). En la provincia de Coclé; existen 53 criaderos de iguana verde (Figura 8). En el cuadro 1 esta escrito la ubicación y la situación actual de los criaderos en Herrera. En el cuadro 2 esta escrito la ubicación y la situación actual de los criaderos en Los Santos. En el cuadro 3a y 3b esta escrito la ubicación y la situación actual de los criaderos en Coclé. Los criadores que tienen iguanas como hobby, significa que se entretienen con la producción, conservando la iguana sin ningún beneficio, excepto de tener la posibilidad de verlas en su patio.

Cuadro 1. Ubicación y situación actual de los criaderos en Herrera.

Productores de Herrera	Lugar	Tipo	Inicio	Producción		# de ♀	Objetivo
				'99	'00		
1. Guillermo Mitre	Llano Grande de Ocú	4	'89	30	40	20	Conservar-comercial
2. Cesar Quintero	Llano Grande de Ocú	4	'89	48	?	?	Conservar-comercial
3. Heriberto Pérez	Llano Grande de Ocú	4	'89	?	?	?	exportar
4. Isaias Caballero	Llano Grande de Ocú	4	'89 ('00)	0	15	?	conservar-comer
5. Erasmo Fung	Llano Grande de Ocú	4	'99	0	218	14	conservar-ingreso
6. Juan Rodríguez	Llano Grande de Ocú	2	'89 ('98)	0	200	21	comercial
7. Luis Carrasco	Llano Grande de Ocú	4	'89 ('99)	300	200	?	educación-comercial
8. Luis Mencomo	Pesé	2	'97	63	0	22	hobby
9. Olegario Guillén	Pesé	2	-	-	-	-	hobby
10. Angel López	Chitré	3	'88	0	1175	67	hobby-comercial
11. Vincente Delgado	Chitré	2	'97	230	225	70	comercial
12. Francisco Ríos	Monagrillo de Chitré	2	'97	400	1150	200	conservar
13. Ricaurte Rodríguez	Monagrillo de Chitré	2	-	-	-	-	-
14. Papo Cedeño	Monagrillo de Chitré	2	-	-	-	-	-
15. Escuela de las Minas	Las Minas	5	-	-	-	-	-
16. Granja Española	Las Minas	5	'98	0	0	?	-
17. Gladys Villareal	Monagrillo de Chitré	2	'98	0	44	?	hobby

? = el productor no sabía, - = faltan datos

Cuadro 2. Ubicación y situación actual de los criaderos en Los Santos

Productores	Lugar	Tipo	Inicio	Producción		# de ♀	Objetivo
				'99	'00		
1 Juan Arosemena	Los Santos	2	-	-	-	-	-
2. Candido Pérez	Los Santos	2	-	-	-	-	-
3. Dr. Vasquez	Los Santos	2	'98	16	2	60?	conservar
4. Dimas Espino	Los Santos	2	'94	185	114	17	hobby
5. Domingo Moreno	Los Santos	2	-	-	-	-	-
6. Toño Batista	El Ejido (cerca Los Santos)	2	-	-	-	-	-
7. Heriberto Castillo	Sta. Ana (cerca Guararé)	2	-	-	-	-	-
8. Liqui Bernal	Sta Ana (cerca Guararé)	2	-	-	-	-	-
9. Iturbides Benavides	Guararé	2	-	-	-	-	-
10. Eric Cordoba	Guararé	2	-	-	-	-	-
11. Benigno Zarzavilla	Guararé Bella Vista	2	-	-	-	-	-
12. Elias Vergara	Guararé Bella Vista	2	-	-	-	-	-
13. Osvaldo Cortez	Guararé Bella Vista	2	'99	0	12	1	hobby
14. Manuel Vasquez	Guararé Bella Vista	2	-	-	-	-	-
15. Elias Leverone	Guararé Bella Vista	2	-	-	-	-	-
16. Aroma Hernandez	Guararé La Pasera	2	'94	36	14	26	criarlo
17. Remigio Cordoba	Guararé La Enea	2	-	-	-	-	-
18. Abel Dominguez	Guararé Montero	2	-	-	-	-	-
19. Baudilio Dominguez	Guararé Montero	2	'97	150	200	20	hobby,comer
20. Alan Urriola	Las Tablas	2	-	-	-	-	-
21. Camilo Vega	Las Tablas	2	'98	300	110	?	hobby
22. Cesar Jaen	Las Tablas, la Ermita	2	-	-	-	-	-
23. Chequelin Díaz	Las Tablas, El Cocal	2	'98	0	6	30	comer
24. Fifi Dominguez	Las Tablas, El Cocal, Peña B.	2	-	-	-	-	-
25. Amador Garcia	El Choclo	2	-	-	-	-	-
26. Maginin Batista	El Choclo	2	-	-	-	-	-
27. Juan Mendoza	Guayabal	2	-	-	-	-	-
28. Lastenia Prado	Pocrí Laguna	2	-	-	-	-	-
29. Damaso Concepción	Pocrí Paritilla	2	-	-	-	-	-
30. Hector Concepción	Pocrí Paritilla	2	-	-	-	-	
31. Minsin Soriano	Pocrí Paritilla	2	-	-	-	-	-
32. Pinpo Vergara	Pocrí	2	-	-	-	-	-
33. ANAM	Tonosí	5	'00	0	500	24	proteger
34. Comunidad	Tonosí Cambutal	1	'00	0	?	-	proteger
35. Comunidad	Tonosí Cortezo	1	'00	0	-	-	proteger
36. Comunidad	Tonosí La Pintada	1	'00	0	-	-	proteger
37. Comunidad	Tonosí Guanico Ariba	1	'00	0	-	-	proteger
38. Comunidad	Tonosí Guanico Abajo	1	'00	0	-	-	proteger
39. Comunidad	Tonosí Cañas	1	'00	0	-	-	proteger
40. Didimo Pimentel	Tonosí Ave Marias	1	'96	?	?	?	proteger-reproducir

Cuadro 3a. Ubicación y situación actual de los criaderos en Coclé

Nombre	Lugar	Tipo	Inicio	Producción		# de ♀	Objetivo
				'99	'00		
1. Ruben Reyes	Vista Hermosa	4	'89	180	183	13	comercial, conservar
2. Claudio Moreno	Penonomé, Caimito	4	'93	-	-	-	-
3. Jeronimo Soto	Rincon de las Palmas	4	'93	-	-	-	hobby, comercial
4. Pedro Domínguez	Rincon de las Palmas	4	'93	0	0	4	conservar
5. Julio Soto	Rincon de las Palmas	4	'93	0	4	3	conservar
6. Juan J. Domínguez	Rincon de las Palmas	4	'96	4	0	4	conservar
7. Ernesto Rodriguez	Rincon de las Palmas	4	'99	-	-	-	conservar
8. Albino Márquez	Pajonal, Piral	4	'93	132	8	21	comercial, consumo
9. Rafael Beltrán	Penonomé	4	'95	150	165	13	repoblar
10. Eduardo Sotillo	Penonomé.	4	'94	232	272	16	conservar, comercial
11. Alex Domingo	Penonomé	4	'95	0	50	4	hobby, repoblar
12. Gladys Taylor	Las Guabas	4	'94	0	225	10	conservar, comercial
13. Javier Arosemena	Churuquita Grande	2	'95	-	-	-	-
14. Roberto Moreno	Las Guabas, Puerto Gago	4	'95	-	-	-	conservar
15. Alcides Miranda	La Pintada, La Pintada	4	'95	-	-	-	conservar, repoblar
16. ANCON	La Pintada, Llano grande	5	'94	10	80	12	repoblar
17. Feliciano Guevara	Aguadulce	2	'97	100	0	26	hobby
18. Eduardo Castroverde	Aguadulce, Pocrí	2	'95	0	0	6	hobby
19. Gonzalo F. Tapia	Aguadulce, Las Mineras	3	'97	10	800	100	comercial
20. Carmen Reyes	Antón, Cabuya	2	'98	-	-	?	comunitario
21. Erasmo Reyes	Cabuya, Cabuyita	2	'85	-	-	-	-
22. Abelino Rodriguez	Cabuya, Barranquilla	2	'94	-	-	-	-
23. Rafael Chu Valdes	Cabuya, Barranquilla	2	'94	-	-	-	comer, comunitario
24. Atanacio Alveo	Cabuya, Granadilla	2	'85	3	100	7	repoblar, proteger
25. Manuel Carvajal	Aguadulce, Florestal	2	'97	3	?	4	hobby
26. Noriel Salerno	Aguadulce	2	-	-	-	-	-
27. Luis Calvo	Aguadulce	2	-	-	-	-	-
28. Marta Ramos	Penonomé, Las Guabas	4	'99	-	-	-	-
29. Diego Martinez	Penonomé, Sardina	4	'96	0	104	5	conservar
30. Juan González	Penonomé, Sardina	4	'96	-	50	4	-
31. Cecilio Moreno	Penonomé, Guabal	4	'95	-	0	10	-
32. Moises Moran	Santa Cruz	4	'93	-	0	6	-
33. Roberto Hernández	Sonadora	4	'97	-	1	2	-
34. Jose Lito Ovalle	Rincon de las Palmas	4	'98	0	0	?	repoblar
35. Efrain Peñaloza	Coclé	4	'97	-	30	1	-
36. Angel Kingrea	El Barrero	4	-	-	4	1	-
37. José Dimas Brandao	Santa María	4	-	0	0	?	-
38. Lilia Moreno	Penonomé, Las Guabas	4	'00	0	0	?	repoblar
39. Daniel Sánchez	Tambo	4	-	-	8	12	-
40. Isaac Rodriguez	El Cope	4	'93	-	0	4	-
41. Aristides Aguirre	Aguadulce, Pocrí	4	'00	0	0	?	-
42. Camila Rojas	La Mata	4	'00	0	0	?	-
43. Alex Gomez	Jaguito	4	-	-	0	10	-
44. Abilio Quiros	Penonomé	4	'00	0	0	?	-
45. Luis A. Sotillo	Las Lomas	4	-	-	0	5	-
46. Gilma de Aguirre	Penonomé	4	'00	0	0	?	-
47. Panamá La Verde	Penonomé, Las Guabas	4	'00	0	0	?	-

Cuadro 3b. Ubicación y situación actual de los criaderos en Coclé

Nombre	Lugar	Tipo	Inicio	Producción		# de ♀	Objetivo
				'99	'00		
48. Betzy G. de Mendoza	Penonomé	4	'97	-	6	10	-
50. Baltazar Montacer	Penonomé, Las Guabas	4	-	-	0	1	-
51. Tomas Rodríguez	Los Uveros	4	-	-	30	3	-
52. Katiuska D. Andrews	Nata	4	'00	0	0	?	-
53. Manuel Amado Ramires	Penonomé	4	-	-	0	20	-
54. Hercilia Marquez	Penonomé, El Piral	4	'99	0	0	?	-
55. Victoriano Gómez	Aguadulce	2	'00	0	100	7	comercial
56. Juan Bultrón	Penonomé, Las Guabas	2	'00	0	0	?	repoblar, conservar

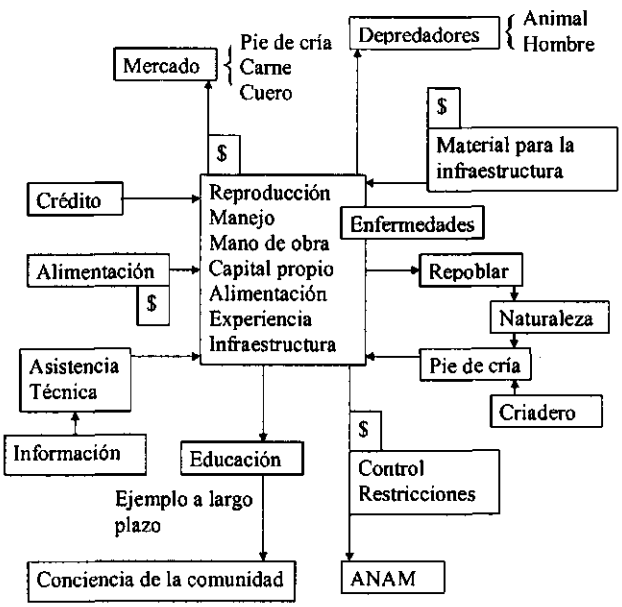
Resultados de las reuniones

Durante las discusiones en las reuniones con los productores se formó el siguiente modelo conceptual de la producción de iguanas (Figura 4). El objetivo de la producción es la conservación de la especie y a la vez obtener un ingreso con la comercialización de los productos de la iguana, en ese caso la carne de los machos que sobren y de las hembras que no ponen, sus pieles y las juveniles como pie de cría.

Las ONG's, autoridades y diferentes instituciones mencionaron mas factores importante de considerar para la producción de las iguanas. Los mas importantes fueron: el espacio por animal, las condiciones del terreno, el clima, marcar los animales para diferenciar iguanas silvestres y en cautiverio, atracción turística, promoción del producto, eliminar la presión sobre los que hay en la naturaleza, y la inversión inicial.

Los siguientes problemas con la producción de iguanas están mencionados por los productores: Alta inversión inicial y altos costos de producción (mano de obra, alimento e insumos costosos); Obtener permiso para comercializar (inscribirse en ANAM); Falta de conciencia de la comunidad: robos; Desconocimiento de la reproducción (especialmente en el principio); Escasez de asistencia técnica y comunicación entre los criadores (aunque están organizado); Falta de conocimiento del mercado; Poca producción para entrar al mercado; Mercado conocido (pie de cría) se llena rápido, desconocimiento de la comercialización.

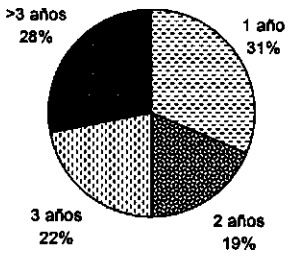
Figura 4. Modelo conceptual.



Causas de los problemas en el criadero:

Los problemas son mencionados por los productores; estos problemas representan errores iniciales porque muchos productores están iniciando su reproducción de iguanas. La mayoría de los productores empezó con juveniles como pie de cría que demoran 3 años para que empiecen a reproducirse. En promedio los productores tienen 2.7 años de experiencia, pero como 31% de los productores esta empezando con la reproducción (Figura 5).

Figura 5. Los años de experiencia de reproducir iguanas.



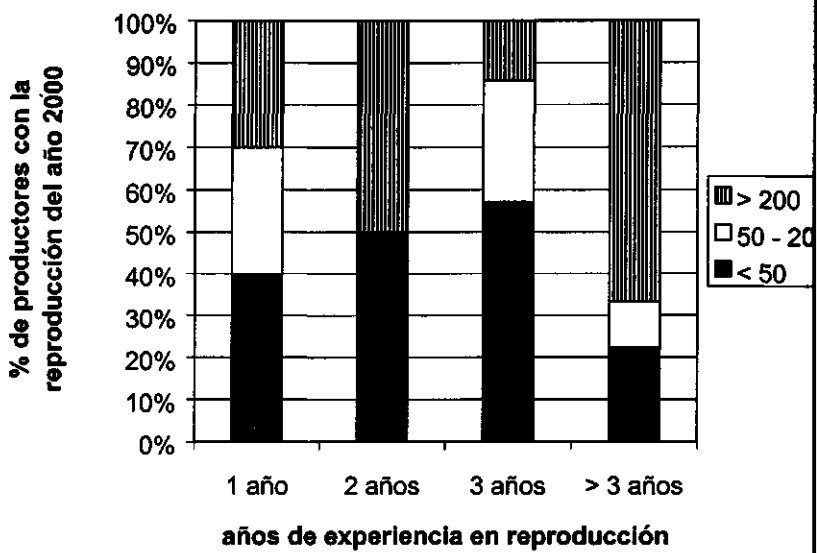
Inscribirse en ANAM

Los miembros de la Fundación Pro Iguana Verde, los de la ASCIASE y los criaderos comunitarios de las comunidades de Tonosí están inscritos en ANAM, aunque la mayoría de los miembros no saben que están inscrito y tienen miedo de acercarse a ANAM, para aclarar las cosas. Hay una fábula persistente que los criadores tiene que pagar $10 por iguana y cuando sus instalaciones no están en orden ANAM quita sus iguanas. Por esta fábula la mayoría de los productores privados no está inscrito en ANAM. Un problema para ANAM es la diferencia entre gente quienes están criando las iguanas como hobby y quienes están criandolas para la conservación, organizados en una asociación o fundación. En la ley de 1995 y las reglas (todavía no publicadas) está escrito que para inscribirse como criadero solo tiene que registrarse en la oficina regional de ANAM, lo cual significa que el 5% de su producción de juveniles tienen que liberar. Los tramites y requisitos para obtener el permiso de comercializar los productos y subproductos de las iguanas son desconocidos por casi todos los productores. A los oficiales regionales de ANAM le falta en muchos casos también el conocimiento para ayudar a los productores que quieren comercializar. Resulta que los requisitos son difícil de cumplir, especialmente para productores pequeños que no están organizados. Solo miembros de la Fundación Pro Iguana Verde en Llano Grande de Ocú tienen el permiso de ANAM para comercializar productos o subproductos de iguanas. Aunque el gobierno nunca ha dado una cuota a la Fundación.

Ignorancia de la reproducción y escasez de asistencia técnica y comunicación

El 31% de los productores tienen solo un año de experiencia y el 19% tiene 2 años de experiencia (Figura 5). Para dominar la reproducción de la iguana, la mayoría de los productores necesita 3 o 4 años. Si la producción del año 2000 se divida en los criaderos que produjeron menos de 50 juveniles, los que produjeron entre 50 y 200 juveniles y los que produjeron mas de 200 juveniles, y se relaciona la producción con los años de experiencia en la reproducción, resulta que los productores con mucha experiencia pueden fallar en la reproducción, igual que los que empezaron hace un año (Figura 6).

Figura 6. La reproducción en el año 2000 relacionado con los años de experiencia en la reproducción.

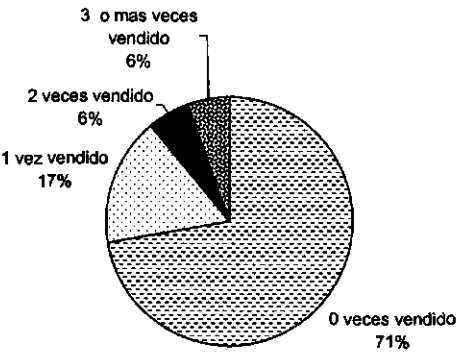


En la Figura 6 esta demostrado que los productores con mas años de experiencia tienen una mejor producción. Por ejemplo, en el año 2000 57% de los productores con 3 años de experiencia tienen una reproducción de menos de 50 juveniles. Entonces no solo la experiencia influye en la reproducción, pero también por ejemplo el clima, la edad y el tamaño del pie de cría, el tiempo que se puede dedicar a las iguanas, depredadores o un cambio de la situación. Por ejemplo, algunos productores de la ASCIASE con más de 3 años de experiencia y una producción decepcionante, cambiaron la jaula y el área de ponedores en el año pasado. Las iguanas y el productor tenia que adaptarse al sistema nuevo. Por todo estos factores, es importante que se puede obtener asistencia técnica y que hay una mejor comunicación entre los productores, para intercambiar experiencia. Muchos productores no han recibido capacitación, ni asistencia técnica y no pueden encontrar literatura sobre la producción de iguanas.

Mercado desconocido

El mercado de los productos de las iguanas está desconocido por los productores. Los robos y el precio de la carne de la iguana en el mercado ilegal son indicaciones que hay una demanda para la carne en el mercado local. Seis por ciento de los productores vendió iguanas para el consumo. Con la venta del pie de cría hay más experiencia en Panamá (29% de los productores ha vendido juveniles como pie de cría para nuevos productores, vea Figura 7), pero como dicen los productores, "si todos se dedicaran a la producción de los pie de cría, el mercado se llenara rápido". Los productores han logrado vender el 88% de su producción a un precio promedio de $1.72 por iguana en el año 1997, 86% de su producción a $1.61 en el año 1998, el 70% de su producción a $1.51 en el año 1999 y el 34% de su producción a $1.77 en el año 2000 (visitamos los productores en el transcurso del periodo de la venta).

Figura 7. El porcentaje de los productores vendiendo iguanas o sus productos.



Alta inversión inicial y altos costos de producción:

La producción de las iguanas en cautiverio tienen altos costos (variando de $53.40 a $91.51 por mes) y la inversión inicial es tan alta (variando de $75.70 a $1256.40 por jaula), que sólo gente de la clase media (con ingreso de $50 a $100 por semana) y clase alta (con ingreso más de $100 por semana) tienen suficiente recursos para montar un criadero. El 36% de los criadores gana menos de $50 por semana, el 19% gana entre $50 y $100 por semana, y el 45% gana más de $100 por semana. Por esta razón que muchos productores mencionaron que la producción es un hobby. Además, el 26% de los productores poseen un terreno de un tamaño menor a una hectárea. La ASCIASE ha obtenido donaciones para que pequeños productores de poco recursos también pudieran empezar. El problema es que los materiales usados son caros y no son sostenibles (la madera tiene que cambiar cada 5 años).

A pesar de todos los problemas podemos probar que la producción de las iguanas es viable y rentable, con la anotación que en un futuro más adelante, además el mercado del pie de cría tiene que abrir otros mercados, por ejemplo el mercado de la carne, usando el subproducto; las pieles. En el cuadro 4 está descrita la situación administrativa actual de cuatro criaderos. Aquí no se ha tomado en cuenta la inversión inicial.

Cuadro 4. La administración de cuatro zoocriaderos

	Pesé	Los Santos	Penonomé	Sardina
producción				
# hembras	34	49	22	20
producción futura en 2001	791	792	680	400
5% a la naturaleza	40	40	136 (20%)[3]	80 (20%)[3]
pie de cría	0	396	80	100
precio promedio	2	2	2	220
ingreso futuro ($) en 2001	1502	712	928	440
costos de producción por año[1]				
alimentación	450	120	534	402.4[4]
desparasitación	0	3.15	0	0
padrotes	0	0	0	0
otros materiales	390.70[2]	60	0	0
mano de obra	207	1653.1	228.13	234
Total	1047.70	1836.25	762.13	636.4
ganancia futura en 2001	454.30	-1124.25	165.87	-196.40
amplificación del criadero				
# de jaulas/módulos	3	1	2	4
juveniles/adultos	adultos y cría	adultos	adultos	adultos
costos total	3769.2	404.35	151.40	300.40
% de ganancia	820%	-	91%	-

[1] no esta incluido la inversión inicial
[2] este año se construyó otra jaula
[3] la asociación pide 20% de sus criadores
[4] usa frutas dañados que bajan los costos

En Pesé los costos de producción del año 2000 son muy altos por la construcción de una jaula (entonces aquí esta incluido la inversión inicial). Si no se incluye la jaula nueva, la ganancia futura sube hasta $845. En Los Santos los costos más altos son el salario del productor (el calculó con su salario actual), si calcula que uno paga una persona para hacer las tareas del criadero se baja los costos de mano de obra hasta $915 y los costos de producción por año hasta $1098.15. Eso significa una perdida más pequeña. En Penonomé y Sardina los criadores son de la ASCIASE y usan jaulas de alambre elevado de la tierra. Los costos más altos son la alimentación; las frutas que ellos siembran en su finca. Las frutas están calculados con un precio del mercado, pero la propia producción es más barato.

Conclusiones y Discusión

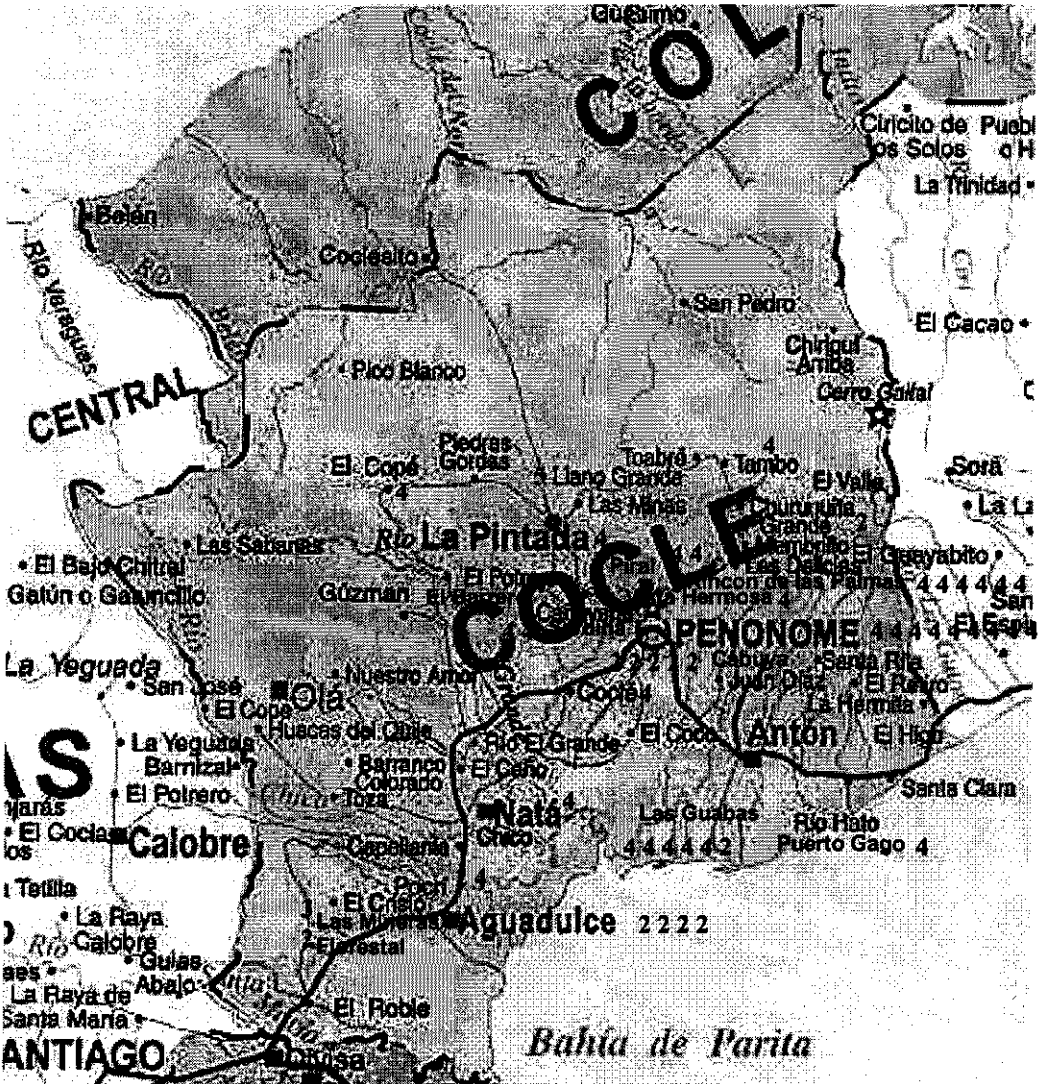
Aunque en Panamá iniciaron la producción de las iguanas en cautiverio en Centro América, la producción todavía no esta reconocido como actividad rentable, y entonces los bancos no ofrecen el servicio de crédito a los productores. La Fundación Natura patrocina proyectos ó grupos organizados de productores, que tienen sustentados sus proyectos. Además es muy difícil de encontrar expertos y/o material didáctico sobre la producción de iguana.

Un problema principal es la poca comunicación entre los productores. En la ASCIASE los asociados van a agregar un punto fijo en la agenda de sus reuniones, para intercambiar experiencia, sea buena o mala y así obtendrán la oportunidad de aprender de los errores y experimentos de otros miembros de la asociación. Los criadores de Herrera y Los Santos intercambiaron números de teléfono para tener contacto y tal vez en un futuro organizarse para darse a conocer, especialmente con ANAM, pero también con futuros clientes y obtener asistencia técnica y permisos de comercialización.

Para resolver los problemas que existen con las leyes ANAM esta capacitando su personal para divulgar mejor la información legal. Además ANAM ofrece (por ley) a los criadores que están inscritos en ANAM asistencia técnica y capacitaciones (en cooperación con ANCON). Hay que acentuar que solo los criaderos que están inscrito en ANAM, puedan tener la posibilidad de vender legalmente sus iguanas.

No tenemos que olvidar que los productores están protegiendo la iguana, evitando que se extinga. Eso demostraron algunos productores cuales anteriormente fueron cazadores fanáticos de las iguanas.

Figura 8. Mapa de los criaderos de Coclé



Leyenda

———	Carretera Principal	2	Criadero Privado
———	Carretera Secundaria	3	Criadero Comercial
★	Cabecera de Provincia	4	Criadero de Asociación
■	Cabecera de Distrito	5	Criadero de Educación
●	Otras Poblaciones		
— — —	Limites Provincial		

Figura 9. Angel (Chacho) López con su iguana Virginia, Chitré. *Foto: Karen Eilers*

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Figura 10: Hijos dando hojas a las iguanas adultas, Rincon de las Palmas. *Foto: Karen Eilers*

Créditos:

Gracias a la Organización Holandesa por la Investigación Científica (NWO) por financiar este proyecto y gracias a la Asociación Nacional para la Conservación de la Naturaleza (ANCON) por su colaboración, a todos los productores y otras personas que nos ayudaron en esta investigación.

Annex 4

Love for the iguanas

C.H.A.M. Eilers

Published to inform stakeholders of iguana production in Costa Rica, November 2000

Abstract

In Costa Rica, iguana production has developed slowly. In 1988, Dagmar Werner started a farm in Costa Rica, with Panamanian iguanas and helped to start a farm in Kéköldi, Talamanca. The foundation Pro Iguana Verde was established and they published booklets about iguana farming. Although the foundation had as objective to diffuse iguana production, the professionals that worked on the farm were prohibited to inform other interested farmers. This and the strict legislation restricted the introduction of iguana farming. At present, there are six iguana farms in Costa Rica, one farm that discontinued and three places (a school, a park, and a zoo) where they reproduce iguanas as a side activity. Farmers mentioned the following problems with the start of the production system: little knowledge about the production and the market and difficult to obtain financial support and permits. Problems experienced with the practice of iguana farming: reproduction problems, high mortality of the young, lack of training, loosing the dedication because of bad reproduction, high production costs and poaching. Five of the six farms started recently and those farmers lack experience in reproducing iguanas. Two subspecies of green iguana are found within the countries borders: *Iguana iguana iguana*, which is found in the south and in Panama and *Iguana iguana rhinolopha*, which is found in south, central and north Costa Rica and in Nicaragua. It is recommended to obtain parent animals from the surroundings of the farm, to prevent mixing of the different subspecies with their presumably different habitat and to prevent an epidemic by transporting animals from one region to the other. With a small investigation it is proven that young iguanas treated with a preventive antiparasitic treatment grow faster than those who were not. To solve the problem of lack of information, it is proposed to establish an information network among stakeholders. In Costa Rica, tourist activities can play an important role to obtain funds for the iguana production, though this has to be developed.

Amor por las iguanas

Elaborado por: C.H.A.M. (Karen) Eilers
Noviembre 2000

Figura 1. Macho de Iguana Verde. *Foto: Karen Eilers*

Estudio de producción de iguana verde

En 1997 Karen Eilers hizo un estudio piloto de los sistemas de producción de las iguanas en tres países, Nicaragua, Panamá y Costa Rica. En el año 2000 ella regresó para ver el desarrollo de la producción de las iguanas, para conocer la situación actual de los criaderos y obtener las fortalezas y los problemas de la producción de la iguana verde.

En Costa Rica la producción de las iguanas se ha desarrollado muy lentamente. En 1988 Dagmar Werner llegó a Costa Rica con sus iguanas de Panamá. Ella empezó con un criadero de iguanas en Orotina y ayudó a iniciar el criadero de Kéköldi, Puerto Viejo, Talamanca. Se formó la Fundación Pro Iguana Verde, que publicó libretas sobre su producción. Aunque la Fundación Pro Iguana Verde tiene como

objetivo la divulgación de la producción, los profesionales que trabajan en ella tienen prohibido extenderla a otros interesados. Eso, junto con la ley estricta de Vida Silvestre lo hizo difícil para los interesados en empezar con la producción.

El objetivo de este estudio es de investigar la situación actual de los zoocriaderos de iguana verde en Costa Rica. En Octubre 2000 visité los criaderos con el propósito de realizar una entrevista para obtener los datos sobre la situación actual. Los productores fueron convocados a dos reuniones con el objetivo de compartir la experiencia e intercambiar ideas y obtener las fortalezas y los problemas de la producción de la iguana verde en la zona.

Así pude obtener una vista general del sistema de producción que me permitió detectar los problemas más importante y su posible solución.

Involucramos en el estudio al Ministerio de Ambiente y Energía (MINAE), CITES, profesionales de la Universidad Nacional de Heredia (UNA), al regente del zoológico Zoo Ave y al profesional de Vida Silvestre de la Escuela Centroamericana de Ganadería, que mostraron interés en la producción de las iguanas, para analizar si las soluciones propuestas por los productores son viables y si éstas pueden fortalecer el sistema de producción.

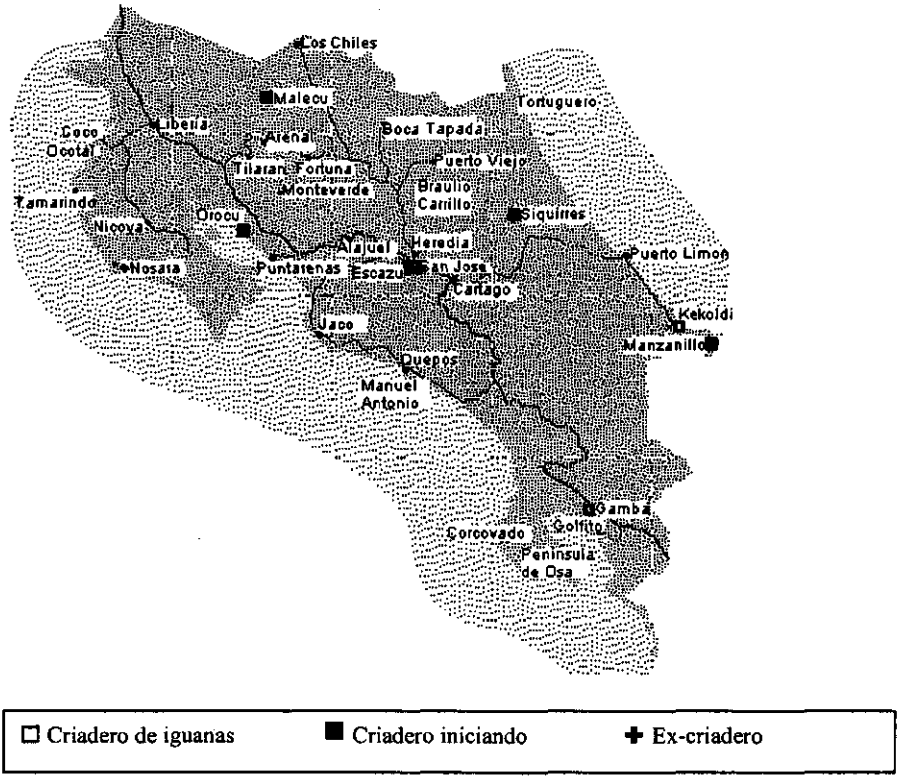

Figura 2: Mapa de los zoocriaderos de iguana verde en Costa Rica

La situación actual

Los criaderos que se encuentran ahora en el país, son criaderos recién iniciados, el criadero de Kéköldi y lugares donde se producen iguanas, pero no como meta principal.

Cuadro 1. Situación actual de los zoocriaderos de Costa Rica

Lugar	Inicio	Tipo	Organización
Kéköldi, Puerto Viejo, Limón	'88	Asociación	International Tree Fund, Canada etc.
Orocu, Punta Morales	'00	Grupo de Mujeres	UNA y Pequeños Fondos de UN
Malecu, Guatuso	'99	Comunidad	U. Europea, Pequeños Fondos de UN
Nosara, Península Nicoya	'95	Asentamiento	IDA-FAO
Manzanillo, Limón	?	Privado	?
La Gamba, Península Osa	'99	?	Neotropica
Siquirres	'00	?	INA

Cuadro 2. Otros lugares donde se produce iguana verde en Costa Rica

Lugar	Inicio	Tipo	Organización	Objetivo
Orotina, Iguana Park	'90	Fundación	Noriega, WWF	Investigar, liberar
La Garita: Zoo Ave	'98	Zoológico	?	Proteger, educar, liberar
Atenas: Escuela de Ganadería	'95	Escuela	ECA	Educación

Resultados de las reuniones

Durante las discusiones en las reuniones con los productores se formó el siguiente modelo conceptual de la producción de iguanas (Figura 3.). Los objetivos de la producción son proteger la especie, conservar la cultura indígena y obtener un ingreso con la atracción del criadero para el turismo, produciendo artesanía con la piel de iguana y cobrando la entrada. Otros objetivos son liberarla en áreas donde la iguana se encuentra en peligro de extinción y educar a la gente. Liberándolas, los indígenas tiene el derecho de cazarlas para el consumo familiar.

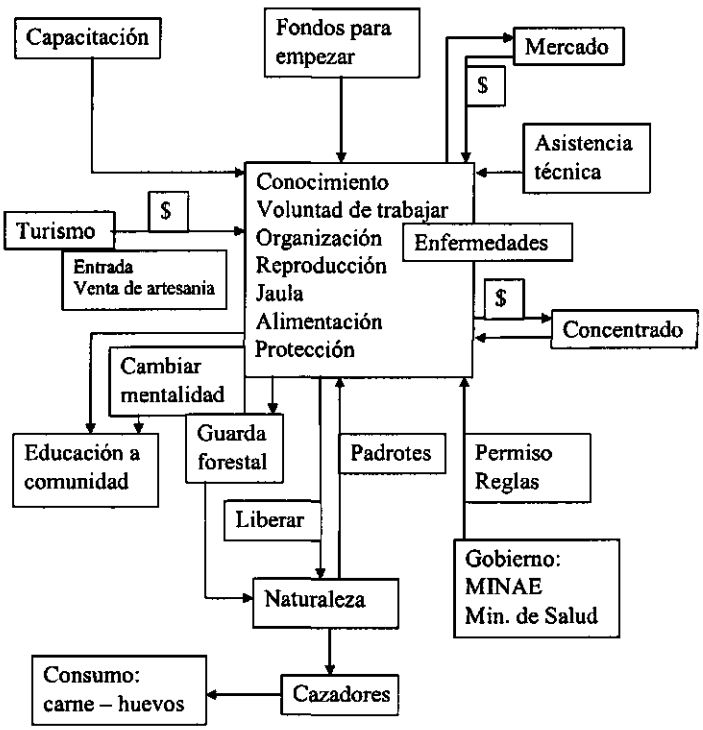

Figura 3. Modelo conceptual

Las autoridades y diferentes instituciones mencionaron más factores importante a considerar para la producción de las iguanas.

Los más importantes fueron:

Aspectos biológicos:

- Subespecies y su distribución

En Costa Rica existen 2 subespecies de la especie *Iguana iguana* (vea la última página).

- Crecimiento

El crecimiento de un reptil como la iguana es muy lento, por eso es difícil de lograr una producción rentable para la obtención de carne. Por la larga duración la gente se desanima.

Aspectos sanitarios:

- Zoonosis

Zoonosis es una enfermedad que se transmite de la iguana al ser humano, por ejemplo, cuando el hombre come carne de iguana, que está cruda o mal cocinada.

- Manejo de desecho

Existen normas del manejo de desecho, pero no saben cómo aplicarlas.

Aspectos legales:

- Marcaje

La mejor forma de marcar las iguanas es con hiero seco al hombro, cuando son recién nacidas.

- Regresar la mascota al productor

Así se evita la mezcla de subespecies, y el productor funciona como un centro de rescate.

- Monitoreo de los zoocriaderos

MINAE tiene que inspeccionar los criaderos 2 veces al año, y el productor tiene que entregar informes sobre su producción.

- Terminar el proyecto

Si los padrotes son de la misma zona, pueden ser liberados mediante un permiso, aunque a riesgo de llevar enfermedades a la naturaleza y causar sobrepoblación.

- Regentes

MINAE tiene que adaptar las reglas para que los regentes cumplan con los requisitos necesarios de conocimiento sobre la especie del criadero.

- Formar una asociación de productores

Los productores van a tener una posición fuerte para negociar y para darse a conocer.

Aspectos económicos:

- Factibilidad

No hay estudios sobre la factibilidad de un criadero de iguanas, pero si el turismo es un objetivo depende del acceso. También tiene que diferenciar los criaderos para que todos sean originales y puedan obtener un bien ingreso.

Aspectos de operación:

- Localización

El MINAE tiene que hacer un mapa con áreas adecuadas para criar iguanas, con los números de criaderos y cantidad de producción.

- Administración

La administración en muchos criaderos es deficiente; los productores necesitan capacitación.

Los siguientes problemas con la producción de iguanas están mencionados por los productores: Se dividieron los problemas en dos puntos de vista. Primero los problemas que el productor encuentra cuando está empezando con la producción:

1. Poco conocimiento sobre la producción de iguanas.
2. Difícil obtener financiamiento para empezar.
3. Difícil obtener los permisos de MINAE.
4. Poco conocimiento del mercado.

Después, los problemas mas importantes que los productores mencionaron con la practica de la producción:

5. Problemas con la reproducción .
6. Mortalidad alta durante los primeros 3 meses.
7. Falta de capacitación.
8. Perder la voluntad de trabajo por fallar en la reproducción.
9. Altos costos de producción.
10. La caza y rapacería que destruyen los resultados de la producción.

Causas de los problemas en el criadero:

Los problemas son mencionados por los productores; la mayoría de los productores

en Costa Rica está iniciando su reproducción de iguanas y todavía carece de experiencia reproduciendo iguanas. Ellos mencionaron los problemas:

1. Poco conocimiento sobre la producción de iguanas.
   Para empezar con la producción de una especie de vida silvestre, tiene que tener conocimiento para escribir un plan de manejo y para saber con qué tipo de producción empiezan. El INA imparte un curso sobre la cría de las iguanas.
2. Financiamiento para empezar.
   Todos los productores mencionaron que es difícil obtener financiamiento para empezar. Las causas son que la producción no es una actividad tradicional, faltan estudios de factibilidad y hay poca información disponible.
3. Dificultad para obtener los permisos de MINAE.
   La ley y las normativas estrictas son difíciles de cumplir y la falta de conocimiento de los técnicos de MINAE, hace más difícil, especialmente para productores pequeños, obtener los permisos.
4. Poco conocimiento del mercado.
   El riesgo de empezar una producción sin conocer el mercado es muy grande.

Los productores nuevos están en diferentes fases de iniciar el criadero. En la figura 2 se puede ver que 4 criaderos están iniciando la actividad, algunos tienen la construcción aunque inadecuada, otros acaban de cazar iguanas para un criadero modelo y otros están entregando su plan de manejo. No existen resultados validos de diferentes métodos de producir en Costa Rica y faltan profesionales con conocimiento y experiencia en producir iguanas. Estas condiciones, junto con dificultades de encontrar capacitación y las leyes estrictas, que son difíciles de aplicar, forman obstáculos grandes para empezar un criadero.

Los problemas más importantes que los productores mencionaron con la práctica de la producción: Sólo un productor y un ex productor tienen experiencia con la reproducción:

5. Problemas con la reproducción.
   Un serpiente (?) bajo tierra que consume los huevos, hormigas que atacan los huevos, hongos e iguanas que no pueden salir del huevo, son problemas encontrados en los criaderos.
6. Mortalidad alta durante los primeros 3 meses.
   Las enfermedades más comunes en la cría que causan la mortalidad alta son la tos, los ataques epilépticos y la expulsión del recto.
7. Falta de capacitación.
   La mayoría de los productores no tenia capacitación o tenia muy poca y en tiempos inadecuados.
8. Perder la voluntad de trabajar por fallar en la reproducción o larga duración del crecimiento.
   Este problema se encontró en todos los criaderos con experiencia en la reproducción.
9. Altos costos de producción.
   Vea el ejemplo en Cuadro 3, no está incluida la inversión inicial o los costos del uso de la tierra.
10. Cazadores y rapaces que destruyen los resultados de la producción.
    Todos los participantes de la reunión mencionaron este problema.

A pesar de todos estos problemas, podemos probar que la producción de las iguanas puede ser rentable (Cuadro 3), con la anotación de que a mediano plazo, no será posible contar con las donaciones, habrá entonces que mejorar el sistema de cobro por entrada y / o buscar otros mercados, como por ejemplo el mercado de la carne. En el cuadro 3 está descrita la situación administrativa actual del criadero con 12 años de experiencia en la producción de iguanas. Aquí no se ha tomado en cuenta la inversión inicial.

Cuadro 3. La administración de un zoocriadero.

Producción	Kéköldi
# hembras	30
Producción futura en 2001	700
100% a la naturaleza	700
Pie de cría	los que sobreviven
Precio promedio	no venden mascotas
Entrada promedio	300 x 1800 = 540.000
Venta de artesanía	16.500
Venta de libro	37.500
Donaciones	157.000
ingreso futuro (Colones) en 2001	**751.000**
Costos de producción[1]	
Alimentación	54.000
Desparasitación	9.000
Padrotes	0
Otros materiales	35.000
Mano de obra	564.000
Veterinaria	0
Total	**662.000**
Ganancia futura en 2001	***89.000***
Mejorar el criadero	
# jaulas	1
Juveniles-adultos	iguanas enfermas
Costos total	51.200
% de ganancia	58%

[1] no está incluida la inversión inicial o los costos del uso de la tierra

En Kéköldi los costos más altos son los de mano de obra. Bajar estos costos no es posible. Aquellos casos en que las donaciones terminan y el libro se acaba, los productores tienen que buscar otra forma de subir el ingreso: están pidiendo un porcentaje del ingreso de las guías turísticas, que con los tours pasan por la finca de iguanas, como primera atracción. Kéköldi tiene la ventaja de que su ingreso no depende de una buena producción de iguanas. Los turistas están atraídos por las iguanas pequeñas y las que están en libertad cerca de las instalaciones.

Las subespecies de iguana verde y su distribución en Costa Rica.

En la última página se encuentran las Figuras 6 y 7 de las diferentes subespecies de la especie *Iguana iguana.* La *Iguana iguana rhincocephala* se encuentra desde el Sur de México al Sur de Costa Rica y la *Iguana iguana iguana* se encuentra desde el Sur de Costa Rica hasta Brasil y en las Islas Orientales. En la literatura no hay acuerdo sobre la existencia de estas subespecies y sus nombres. Aunque la posibilidad de existencia de subespecies y los diferentes hábitats en que se encuentra la *Iguana iguana,* forman dos razones por la cual se debe evitar el traslado de individuos de un lugar a otro. Así, se evita mezclar dos subespecies e iniciar una epidemia con el traslado de enfermedades de una región a otra. En este momento no está prohibido el traslado de las especies de vida silvestre dentro los límites del país y con la venta de iguanas para mascota se ha provocado que las subespecies se hayan distribuido por todo

el país. El MINAE debe exigir que los padrotes de un criadero provengan del mismo hábitat y de la misma región donde se construye el criadero y que las mascotas grandes e insoportables dentro la casa, se regresen al productor.

Investigación sobre el crecimiento de las iguanas en el criadero de Kéköldi.

Durante el año 2000, los juveniles del criadero de Kéköldi, Puerto Viejo de Talamanca, están seguidos en su crecimiento. Las iguanas están medidas y pesadas desde su nacimiento hasta la edad de 4 meses. Cuando nacieron, ellas fueron colocadas en sus jaulas, donde se ubicaron hasta 100 juveniles juntas. Para cada medición capturamos 10 juveniles por jaula para obtener un promedio de su crecimiento en cautiverio. En la jaula 1 se desparasitó cada iguana, al nacer, con una gota de Panacur.

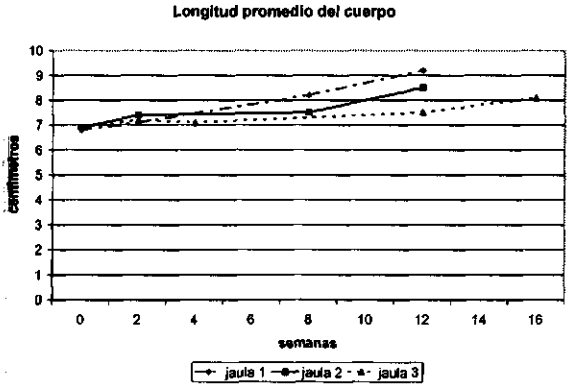

Figura 4. Longitud promedio del cuerpo de la cría por jaula.

En las Figuras 4 y 5, se puede ver que las juveniles que recibieron el desparasitante crecieron más que las sin desparasitante. Las señoras productoras dijeron que van a aplicar este desparasitante el año siguiente a todas las iguanas nacidas.

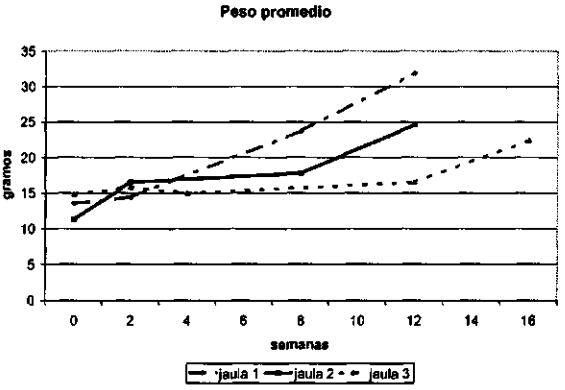

Figura 5. Peso promedio de la cría por jaula.

Conclusiones y Discusión

Para solucionar los problemas con la falta de información y capacitación se puede formar una red de información e intercambio de ideas, experiencias e investigaciones de funcionarios del MINAE, ONG's, universidades y una asociación de productores de iguana verde. Esta red se reunirá 2 veces al año en talleres integrales. Esta red puede funcionar para mejorar y especificar las reglas del establecimiento de un criadero de iguanas y para vender las ideas de conciencia y protección, obteniendo fondos.

En Costa Rica el turismo es una manera importante de obtener un ingreso con el criadero. Se puede mejorar mucho en los criaderos mismos; darse a conocer con rótulos, artículos en periódicos y tratar de diferenciarlos de otros criaderos; explicar la producción en charlas o tours. El estudio de mercado se puede solicitar al Instituto Costarricense de Turismo. Así será posible promover la producción de iguana verde como una alternativa para productores pequeños. Para que funciona el criadero los productores necesitan tener amor por las iguanas y algunos técnicos que comparten este amor.

Las subespecies de Costa Rica:

Figura 6. *Iguana iguana iguana* (LINNAEUS 1758)

Figura 7. *Iguana iguana rhinolopha* (WIEGMANN 1834)

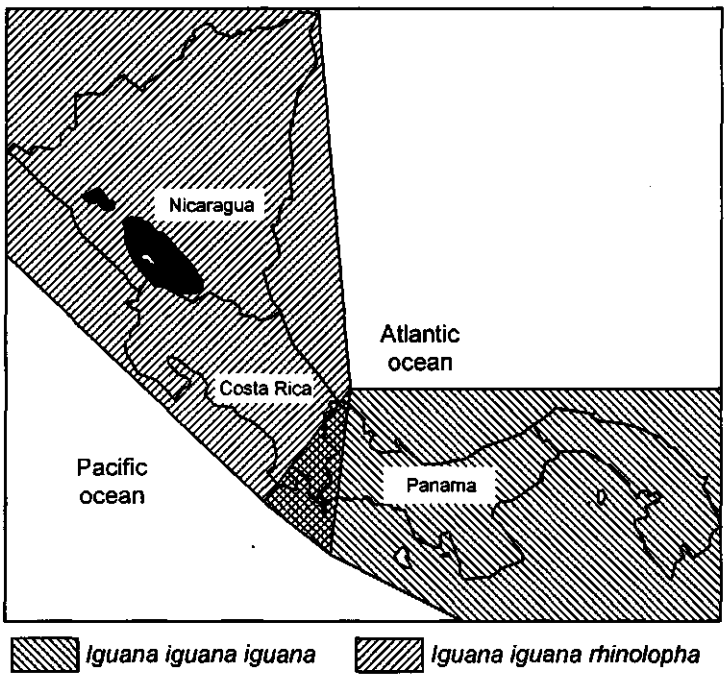

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Figura 8. Mapa teórico de la distribución de las subespecies en Costa Rica.

Créditos:

Gracias a la Fundación Neerlandesa para el Fomento de Investigaciones Tropicales (WOTRO) Postbus 93138, 2509 AC Den Haag, Holanda, por financiar este proyecto y gracias a la Escuela de Medicina Veterinaria por financiar este boletín, a todos los productores y a los involucrados que me ayudaron en esta investigación.

Annex 5

Written survey about production systems with "new" animal species

The Animal Production Systems Group (APS) of Wageningen University is approaching experts on the development of 'new' animal production systems for wild (uncommon) animal species. Animal production systems are systems in which animals are reproduced with a specific goal, varying between nature conservation and the production of meat. Through this written survey, Karen Eilers, a research fellow with APS, wants to obtain a better understanding of the development of these systems, their prospects, and their constraints. The survey consists of 32 questions and to complete the survey will take about half an hour. The data resulting from this survey will be handled confidentially. The results of the survey will be used for a concluding publication of a research project about iguana production systems in Central America. In this publication, experiences gained in research on iguana production systems will be compared with experiences of experts regarding the development of other new systems. If you have any questions, please contact Karen Eilers by e-mail (karen.eilers@dps.vh.wag-ur.nl), or by phone (+31 317 484626) or fax (+31 317 485550). If you think you do not have the expertise on this subject, please forward this survey to someone you consider to be an expert in the area of .... production in .....

Within the survey, the use of "new" animal production systems distinguishes four phases:
Phase 1: Introduction of the new production system on a small scale (as a test case).
Phase 2: Evaluation of the introduction of this system (evaluation of the test case).
Phase 3. Application of the system on a large scale
Phase 4: Development of the system in the long term

Below starts a survey about ..... production system in .....

The first group of questions is about the history of the production system.

1a. Is the animal indigenous for the country.....?
(Mark one answer)
☐ Yes *(Continue with question 1b)*
☐ No *(Continue with question 2)*

1b. Was the animal species hunted before it was domesticated?
(Mark one answer)
☐ Yes *(Continue with question 1c)*
☐ No *(Continue with question 1d)*

1c. If the answer is yes; with what objective was the animal hunted?
(Mark the answer, more than one answer is possible)
☐ meat ☐ hides ☐ talisman ☐ offering
☐ fat ☐ eggs ☐ other.....

1d. If the answer was no; was the animal species used in any other way?

---

2. In which country was the animal species first domesticated?

3a. In what year was the animal species first domesticated?

3b. With what purpose was the animal species first domesticated?

(Mark the answer, more than one answer is possible)

☐ meat ☐ hides ☐ talisman ☐ offering ☐ traction

☐ fat ☐ eggs ☐ research ☐ other.....

The second group of questions is about phase 1, the introduction of the production system.

4a. Were characteristics of the animal species for use in production systems studied before the introduction of the production system?

(Mark one answer)

☐ Yes *(Continue with question 4b)*

☐ No *(Continue with question 5a)*

4b. If the answer is yes; in what country was the study conducted?

_____

4c. Who did this study of the possibilities of using this animal in a production system?

_____

4d. Can you give references to this study:

_____

5a. Were possible production systems with this animal species studied before the introduction of the production system?

(Mark one answer)

☐ Yes *(Continue with question 5b)*

☐ No *(Continue with question 6a)*

5b. If the answer is yes; in what country was the study conducted?

_____

5c. Who did this study of the possible animal production systems?

_____

5d. Can you give references to this study:

_____

6a. Were feasibility studies of the production system conducted before the introduction?

(Mark one answer)

☐ Yes *(Continue with question 6b)*

☐ No *(Continue with question 7)*

6b. If the answer is yes; in which area was the feasibility study done?

(Mark the answer, more than one answer is possible)

☐ economic ☐ other.....

☐ technical

6c. In what country was the feasibility study done?

_____

6d. Who did the feasibility study?

_____

6e. Can you give references to this study:

_____

7. In what year was the production system introduced in your country?

____

8. Who took the initiative to introduce the new production system?
(Mark the answer, more than one answer is possible)
- ☐ government
- ☐ university of .....
- ☐ NGO, viz.....
- ☐ company, viz.....
- ☐ information organisation, viz.....
- ☐ co-operative, viz.....
- ☐ others, viz.....

9. Who was the target group of the production system and where were they located?
(Describe briefly the target group and the area: e.g., subsistence farmers in province X)

_____

10a. With what objectives was the production system introduced?
(Mark the answer, more than one answer is possible)
- ☐ meat for .....
- ☐ fat for .....
- ☐ hides for .....
- ☐ eggs for .....
- ☐ other products, viz.....
- ☐ sacrificial offering.....
- ☐ research for.....
- ☐ income
- ☐ export of .....
- ☐ for national market
- ☐ selfsufficiency of the family
- ☐ tourism
- ☐ education about animal species
- ☐ consciousness-raising of .....
- ☐ nature conservation
- ☐ other.....

10b. Were these objectives reached?
(Mark one answer)
- ☐ Yes *(Continue with question 11)*
- ☐ No *(Continue with question 10c)*
- ☐ Partly *(Continue with question 10c)*

10c. If the answer is no or partly; explain why these objectives were not reached:

_____

11. Who were the stakeholders of the production system during its introduction?
(Mark the answer, more than one answer is possible)

- ☐ national government
- ☐ local government
- ☐ advisers
- ☐ non-governmental organisations viz.....
- ☐ middlemen
- ☐ suppliers
- ☐ consumers
- ☐ farmers
- ☐ family members of farmers
- ☐ neighbours
- ☐ others.....

12. How was the production system introduced?
(Mark the answer, more than one answer is possible)

- ☐ on experimental farms (governmental or NGOs)
- ☐ on a commercial farm
- ☐ on various smallholder farms
- ☐ by courses to extension advisers
- ☐ by courses to farmers
- ☐ with subsidies
- ☐ with credit schemes
- ☐ with the establishment of study groups
- ☐ by organising people who kept those animals already
- ☐ other.....

13. What problems were encountered with the introduction of the production system?
(Mark the answer, more than one answer possible)

- ☐ no problems
- ☐ economic problems
  - ☐ no donors
  - ☐ no budget for research
  - ☐ no funds available from NGOs / governments
  - ☐ expensive to introduce
  - ☐ no market for products
  - ☐ other.....
- ☐ ecological / biological problems
  - ☐ animal introduced outside its habitat
  - ☐ behaviour of animal makes it difficult to keep
    - ☐ solitary ☐ aggressive ☐ needs a lot of space
  - ☐ animal does not breed in captivity
  - ☐ number of offspring is small per year
  - ☐ diseases
  - ☐ difficult to obtain parent animals
  - ☐ other.....

- ☐ social problems
  - ☐ animal is not accepted as farm animal
  - ☐ people do not have interest in the new animal species because.....
  - ☐ no organisations to stimulate the new production system
  - ☐ cultural / religious values and standards are a restriction by.....
  - ☐ low educational level of target group
  - ☐ competes with labour for other activities at the farm
  - ☐ other.....
- ☐ technical problems
  - ☐ little / no knowledge available about the production system
  - ☐ too little material available, in particular.....
  - ☐ difficult reproduction procedure
  - ☐ feed difficult to obtain / to cultivate
  - ☐ too little veterinarian help available
  - ☐ other.....

14a. How would you assess the introduction phase?

(Mark one answer)

☐ very good ☐ good ☐ reasonable ☐ bad ☐ very bad

14b. Motivate your assessment of the introduction phase:

_____

14c. Please give recommendation to improve the introduction of the production system:

_____

The next questions are about phase 2, the evaluation and possible adaptation of the production system.

15. How was the production system evaluated?

(Mark the answer, more than one answer is possible)

- ☐ no evaluation
- ☐ interviewing farmers with experience in the production system
- ☐ report of extension advisers
- ☐ asking stakeholders
- ☐ counting the number of farmers who implemented the production system
- ☐ based on evaluations of other organisations / countries
- ☐ other.....

16. What problems were experienced while keeping the animals?

(Mark the answer, more than one answer is possible)

- ☐ no problems
- ☐ economic problems
  - ☐ high investments
  - ☐ high cost price for
    - ☐ labour ☐ land ☐ feed costs ☐ other.....
  - ☐ no market for products

- ☐ only illegal commerce
- ☐ no infrastructure (transport / middlemen etc.)
- ☐ low sale price
- ☐ no subsidies
- ☐ no credit scheme
- ☐ no donors
- ☐ other.....

☐ ecological problems
- ☐ predators
- ☐ diseases
- ☐ with escape animal becomes a plague
- ☐ climate / environment unsuitable for reproduction
- ☐ climate / environment unsuitable for cultivation of feed
- ☐ animal aggressive / unmanageable (also young born in captivity)
- ☐ parent animals are difficult to obtain
- ☐ other.....

☐ social problems
- ☐ animal is legally protected
- ☐ animal not accepted as owned by the farmer
- ☐ new production system is not accepted
- ☐ theft
- ☐ poaching
- ☐ destruction
- ☐ changing roles of family members (explain: .....)
- ☐ cultural / religious problems.....
- ☐ other.....

☐ technical problems
- ☐ many losses with adult animals by.....
- ☐ bad reproduction by.....
- ☐ survival of offspring is low by.....
- ☐ too little time for care
- ☐ no feed / bad quality feed available
- ☐ too little experience-knowledge available
- ☐ other.....

17a. Was the production system adapted (after the evaluation)?

(Mark one answer)

☐ Yes *(Continue with question 17b)*

☐ No *(Continue with question 18)*

17b. If the answer is yes; on which aspects was the production system adapted?

(Describe briefly the adaptations)

☐ Economic

_____

☐ Ecological

_____

☐ Social

_____

☐ Technical

_____

☐ Other

_____

18. What were the recommendations based on the evaluation?

(Mark the answer, more than one answer is possible)

☐ expand production system and introduce to a larger group of people
☐ adapt production system and introduce to a larger group of people
☐ preserve production system for people who are implementing it; not spreading it any further
☐ stop with production system
☐ other.....

19a. How would you assess the evaluation phase?

(Mark one answer)

☐ very good ☐ good ☐ reasonable ☐ bad ☐ very bad

19b. Motivate your assessment of the evaluation phase:

_____

19c. Please give recommendation to improve the evaluation of the production system:

_____

The following group of questions is about phase 3, the application of the production system on a larger scale.

20a. Was the production system implemented on a larger scale?

(Mark one answer)

☐ Yes *(Continue with question 20c)*
☐ No *(Continue with question 20b)*

20b. If the answer was no: Why not? *(Continue with question 25a)*

_____

20c. If the answer is yes: On what scale was the production system implemented?

(Mark one answer)

☐ regionally ☐ nationally ☐ internationally

20d: If the answer is yes: Who took the initiative to introduce it on a larger scale?

_____

20e. What was the target group of the production system on a larger scale?

_____

20f. With what objectives was the production system implemented on large scale?

_____

21. What changes took place to implement the production system on a larger scale?

(Describe briefly the changes)

☐ No changes

☐ Legal

_____

☐ Organisational

_____

☐ Educational

_____

☐ Commercial

_____

☐ Management

_____

☐ Other

_____

22. Who are the stakeholders of the production system during implementation on a larger scale?

(Mark the answer, more than one answer is possible)

☐ national government
☐ local government
☐advisers
☐ non-governmental organisations like.....
☐ middlemen
☐ suppliers
☐ consumers
☐ farmers
☐ family members of farmers
☐ neighbours
☐ others.....

23. What problems were experienced with implementation of the production system on a larger scale?

(Describe briefly the problems)

☐ No problems
☐ Economic

_____

☐ Ecological

_____

☐ Social

_____

☐ Technical

_____

☐ Other

_____

24a. How would you assess the application on larger scale?

(Mark one answer)

☐ very good ☐ good ☐ reasonable ☐ bad ☐ very bad

24b. Motivate your assessment of the application on larger scale:

_____

24c. Please give recommendation to improve the application on larger scale:

_____

The final questions are about phase 4, the development of the production system in the long term.

25a. How is the production system developing in the long term?

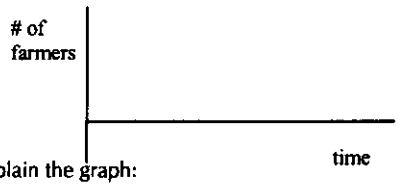
(Mark one answer)

□ very good □ good □ reasonable □ bad □ very bad

25b. Clarify the score of the development in the long term:

_____

26a. Indicate in a graph below the course of development of the production system in time, with the number of farmers on the y-axis.



26b. Explain the graph:

- Give a time scale for the graph (start, period at top of graph, now)
- Estimate the number of farmers at the top of the graph
- Describe the course of the graph (what happens at the top of the graph)

_____

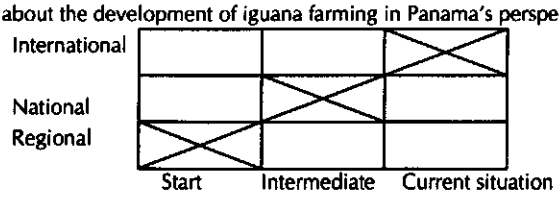
27a. Indicate in the following scheme the course of development of the production system in the long term (in your country's perspective).

There are three phases of development distinguished:

- START: The introduction and evaluation: Was the system introduced at a regional, national or international level?
- INTERMEDIATE: The implementation of the system on a larger scale: How did the system develop?
- CURRENT SITUATION: In what position is the system at the moment?

For example: Iguana farming in Panama started regionally in the province Coclé; during the intermediate phase the production system further developed on a national scale. Next, international organisations in e.g., Costa Rica and Nicaragua learned about the success of the project and started iguana production.

Scheme about the development of iguana farming in Panama's perspective:



Please complete the scheme for the development of the new production system in your country's perspective:

International			
National			
Regional			
	Start	Intermediate	Current situation

27b. Explain briefly the course of development as given in the scheme:

_____

If the production system only had a start phase (the introduction and evaluation), continue with question 31.

28a. Did the target group change during the implementation of the production system?
(Mark one answer)
☐ Yes *(Continue with question 28b)*
☐ No *(Continue with question 29a)*

28b. If the answer is yes: Describe why and how the target group changed:

_____

29a. Did the objectives of the production system change during the implementation?
(Mark one answer)
☐ Yes *(Continue with question 29b)*
☐ No *(Continue with question 30a)*

29b. If the answer is yes: What was the objective of the production system during the development in the long term?
(Mark the answer, more than one answer is possible)
☐ meat for .....
☐ fat for .....
☐ hides for .....
☐ eggs for .....
☐ other products, viz.....
☐ sacrificial offering .....
☐ research for.....
☐ income
☐ export of .....
☐ for national market
☐ selfsufficiency of the family
☐ tourism
☐ education about animal species
☐ consciousness-raising of .....
☐ nature conservation
☐ other .....

29c. Why was the objective of the production system changed?

_____

30a. Who are the stakeholders of the production system during the development in the long term?

(Mark the answer, more than one answer is possible)

- ☐ national government
- ☐ local government
- ☐ advisers
- ☐ non-governmental organisations (NGOs), viz.....
- ☐ middlemen
- ☐ suppliers
- ☐ consumers
- ☐ farmers
- ☐ family members of farmers
- ☐ neighbours
- ☐ others.....

30b. Were there conflicts among the objectives of the stakeholders?

(Mark one answer)

- ☐ Yes *(Continue with question 30c)*
- ☐ No *(Continue with question 31)*

30c. If the answer is yes; what conflicts?

Stakeholder: _____
Objective: _____
Stakeholder: _____
Objective: _____
Stakeholder: _____
Objective: _____

30d. Explain the conflicts:

_____

31a. What is your opinion about the future of the production system?

(Mark only one answer)

☐ positive ☐ neutral ☐ negative

31b. Please explain your answer:

_____

32. Please suggest relevant literature in which the development of the system is described:

_____

This was the last question of this survey. Thank you for completing the survey.
Do you have comments or recommendations?

_____

Would you like to receive the publication?

Yes / No ***If the answer is yes; your mailing address is:***

_____

Curriculum vitae

Catharina Helena Antonia Maria (Karen) Eilers werd geboren op 20 juli 1970 in Dongen. Na het behalen van het VWO diploma aan het St. Willibrord Gymnasium te Deurne, begon zij in 1988 met de studie Zoötechniek aan de toenmalige Landbouw Universiteit te Wageningen. In augustus 1994 sloot zij haar studie af met drie afstudeervakken: parasitologie, gezondheidsleer en dierlijke productie systemen; en twee stages in Costa Rica en Kenia. In november en december 1994, maart 1995 tot en met december 1996 werkte zij als toegevoegd onderzoeker bij de leerstoelgroep Dierlijke Productie Systemen. In die tijd schreef zij drie dictaten en gaf les, begeleidde studenten en ontwierp een voorlichtingsfolder en voorlichtingsvideo voor de leerstoelgroep. In februari 1997 begon zij als assistent in opleiding (AIO) met het promotieonderzoek bij Dierlijke Productie Systemen. Het voor u liggende proefschrift is het resultaat van dit onderzoek, waarvoor ze gedurende anderhalf jaar in Nicaragua, Costa Rica en Panama is geweest. De bijbehorende opleiding genoot ze bij onderzoeksschool WIAS (Wageningen Institute of Animal Sciences). Gedurende haar promotieonderzoek haalde zij haar onderwijscertificaat. In oktober 2000 werd haar het Storm-van der Chijs Stipendium toegekend vanwege haar creatieve inbreng en eigen initiatief in het promotieonderzoek, internationale profilering en inzet om het onderzoek maatschappelijk en wetenschappelijk breed in te bedden.

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