AMAN-IMAN

ECOLOGICAL MARKET GARDEN, INADOUGOUM

Opportunities for ecological market garden | Anne Bouwmeester (V6A), Adam Laftih (V6T) and Brent Riechelman (V6T)

Table of contents

Introduction

The village of Inadougoum (see figure 1) is situated in the middle of the Sahel, distanced about 80 km from the nearest city Tahoua. The total area of the village comprises 900 km^2, consisting of ten village communities. Inadougoum has approximately 10,000 people with 50,000 heads of cattle. The inhabitants were deprived of any form of public utilities, including drinking water. The water that people used to drink was extremely polluted. As a result, many people fell ill and eventually died, especially children (Aman-Iman, 2013).

Figure 1: Geographical location of Inadougoum, Niger (Aman-Iman, 2013).

The Aman-Iman Foundation ('water is life') aims to better the standard of living of the people of Inadougoum. A recent project of Aman-Iman, the constructing of a water installation, was successful. All of Inadougoum's inhabitants now have access to clean drinking water (Aman-Iman, 2013).

The building of a granary was another project of Aman-Iman. Since the granary was built, the occurrence of major famine has disappeared altogether. However, the diet of the people of Inadougoum remains unvariegated. Creating market gardens in and around the village could be a solution to this problem (Aman-Iman, 2013).

Structure of the extended essay

This report will deal with the new project of Aman-Iman to create market gardens. The research question is formulated as follows:

How can the people of Inadougoum (Niger) create sustainable, ecologically sound market gardens with high yield in/near their village? And what sort of business plan would they need to form a corporative?

The research question will be answered by means of the following sub-questions:
1. How Inadougoum's physical dimension be explained and how does its physical dimension influence the way farming can take place? What farming optimization techniques fit Inadougoum's physical dimension best?
2. What possible crops fit Inadougoum's prospective market gardens best and how do these crops form a healthy diet for Inadougoum's inhabitants?
3. What type of business fits the market garden of Inadougoum best? What is needed for setting up a proper business?

We have chosen this assignment, because we found its interdisciplinary character a challenging way to bring together all of the knowledge we have acquired over the past six years into an extended essay. In this extended essay we have used two geographical procedures: deduction and the changing of spatial scale levels. For the business plan we have consulted experts on setting up a business in developing areas and have consulted books on setting up a proper business plan.

The report is structured as follows: In three chapters tree sub-questions will be answered which clarify all concepts from the research question. Every sub-question ends with a summarizing conclusion. The research question will be answered in a general conclusion which is based on the information from the sub-questions.

Chapter 1 Inadougoum's physical dimension and farming optimization

In this chapter, we will describe and explain the physical features of Inadougoum that influence the way farming should take place. These features include climate and soil properties.

Chapter 1.1 Inadougoum's climate

Classification

In Niger one can distinguish two types of climate zones: the Saharan zone in northern Niger and the Sahelian climate zone in southern Niger. The former is an arid climate zone which receives about 160 mm precipitation in a year. The latter receives 200-600 mm per year of precipitation with a wet season from June to September and a dry season the rest of the year. As one can observe dry and wet seasons in Inadougoum as well, one can classify Inadougoum's climate as a Sahelian climate (Aman-Iman, 2013; Bulthuis, 2007; FAO, 2001).

Sahelian climate

Met Office (2010) has defined the Sahelian climate zone as "a transition zone between Saharan Africa and the wet climate of tropical Africa." One can deduce from this fact that the mean annual temperatures are above 20˚C due to Inadougoum's approximate equatorial, non-elevated location. As mentioned earlier, the Sahelian climate zone in which Inadougoum is located receives 200-600 mm rain per year. The wet season develops in April and ends in October. The actual precipitation falls from June to September (Met Office, 2010).

The main feature of this climate, explaining both the amount of precipitation falling per year and the time of the year in which rain falls, is the West African Monsoon (WAM) system. Met Office (2010) describes the WAM system as "a recurrent low latitude large-scale circulation pattern arising from the meridional boundary layer gradient of dry and moist static energy between the warm sub-Saharan continent and the tropical Atlantic Ocean." It is due to the WAM system that the Inter-Tropical Convergence Zone (ITCZ)[1] and its rainfall maxima are being brought to their northernmost location in August. The location of the ITCZ, then, determines which site in the Sahel receives precipitation (Met Office, 2010).

Met Office (2010) has further mentioned that "the intraseasonal migration of rainfall maxima is a discontinuous and nonlinear process with three main phases: (i) the preonset or arrival of the intertropical front (ITF)[2] at 15ºN in May, bringing enough moisture for isolated convective system to develop over the Sahel; (ii) the onset which occurs at the end of June and corresponds to the abrupt latitudinal shift of the ITCZ from a quasi-stationary location at 5ºN in May-June to another quasi-stationary location at 10ºN in July-August, and (iii) the retreat of the ITCZ towards the equatorial Atlantic ocean, which occurs in September – October." So the ITCZ passes every location in the Sahel twice. The first time that the ITCZ passes a place is when it moves north and the second time is at the end of the wet season when the ITCZ retreats. This explains why the movement of the rainfall maxima is discontinuous and nonlinear (Met Office, 2010).

Climate variability and its effects on farming

The Sahelian climate zone is identified by its stark climatic fluctuations and erratic rainfall

[1] The Inter-Tropical Convergence Zone is a belt of depressions where converging northeast and southeast trade winds which moves up or down in line with the transition of seasons. In July the ITCZ is located on its northernmost location and as a result of this it is summer on the Northern Hemisphere and winter on the Southern Hemisphere. In January the ITCZ is located on its southernmost location and as a result of this it is winter on the Northern Hemisphere and summer on the Southern Hemisphere (Bulthuis, 2007).

[2] ITF is an obsolete name for ITCZ

patterns that range as mentioned by UNEP (2006) between 200-600 mm per year with coefficients of variation ranging from 15 to 30 percent. Relatively wet years alternate with drier years and vice versa. As precipitation in the Sahelian climate zone is limited to only 3-4 months, farming sectors like agriculture are vulnerable. UNEP (2006) further mentioned that 'droughts with varying degrees of severity occur in two out of every five years, making harvests of the major food and cash crops highly uncertain.' Therefore measures to obtain a stable food supply through agriculture ought to be adapted to the climate variability of the region.

Chapter 1.2 Inadougoum's soil conditions

Classification

Using the approximate location of Inadougoum, we find that Inadougoum's soil is a Luvic Arenosol (see figure 2). Arenosols are naturally relatively infertile, lack commonly certain minor elements, have a low cation exchange capacity and are incapable of retaining water. The arenosols are additionally vulnerable to wind and water erosion when vegetation is absent. As soon as the wet season commences and rain and weathering become regular, the upper horizon of the soil gets a light color, indicating that little organic matter is present. The lower horizon gets a reddish color which means that a high iron concentration is present in the soil. The Luvic Arenosol furthermore possesses thin layers of accumulated clay, preventing the soil from becoming infertile altogether (FAO, 2001; Mapcoordinates.net, 2013).

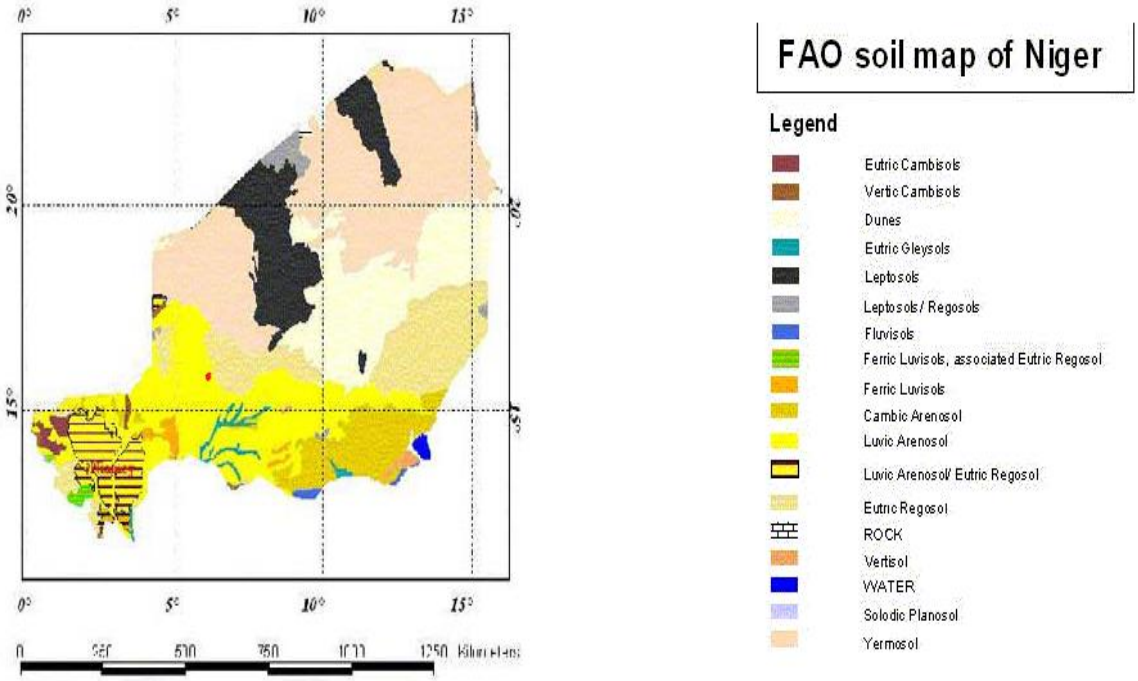

Figure 2: Niger's soil types (the red dot located 6˚E 16˚N is the approximate location of Inadougoum)

The effects of soil conditions on farming
Due to the fact that during the fertility spell of the Luvic Arenosol there is little organic material present, one can only grow crops that demand little amounts of nutrients such as millet or groundnut. The usage of organic or inorganic fertilizers to add more nutrients to the soil is an option, but as mentioned earlier, climate variability forms a high risk for crop failure and may result in profit loss. As the Luvic Arenosol is prone to erode rapidly, possible torrential rainfall during the wet season could cause the little amount of nutrients being present to be leached to the groundwater, hindering crop growth catastrophically. It is for this reason that farming optimization techniques that limit water and wind erosion are a prerequisite in order to establish sustainable agricultural activity.

Chapter 1.3 Farming optimization techniques
In the preceding two sections, we analysed how two physical features of Inadougoum have an effect on the way farming can take place. We will now mention some farming techniques that fit Inadougoum best. As we mentioned earlier, agriculture has to be adapted to climatic fluctuations and the farming techniques used for agriculture should limit water and wind erosion. In order to make all of this possible, the following two techniques should be used: agroforestry and micro-irrigation.

What is agroforestry and how is it applicable to Inadougoum?
Agroforestry describes the planting of trees besides agricultural activities. The World Agroforestry Centre (2014) has defined agroforestry as follows: "Agroforestry focuses on the wide range of working trees grown on farms and in rural landscapes. Among these are fertilizer trees for land regeneration, soil health and food security; fruit trees for nutrition; fodder trees that improve smallholder livestock production; timber and fuel wood trees for shelter and energy; medicinal trees to combat disease; and trees that produce gums, resins or latex products. Many of these trees are multipurpose, providing a range of benefits.[3]"

UNEP (2006) mentions the following regarding the benefits of agroforestry in the Sahel region: "Promising technologies include … windbreaks for wind-induced soil erosion control, and improved fallow to enhance soil fertility and reduce soil losses."

Besides combatting problems such as soil erosion, agroforestry has also been proven to effectively resist erratic climate patterns (either a lack or a surplus of precipitation), pests, diseases and weeds (UNEP, 2006).

Agroforestry is particularly interesting for Inadougoum to level out production risks that are a result of climate variability. An example of agroforestry that is applicable to Inadougoum are parkland farming systems. In a parkland farming system, trees that have been selected on usefulness are being scattered over a piece of land. The planted trees will then prevent the upper layer of the soil with its nutrients from wearing away due to the wind (UNEP, 2006; Bulthuis, 2007).

An interesting example of a useful tree in a parkland system is Faidherbia albia. UNEP (2006) mentions the following regarding this tree: "One of the most valued (and probably most intriguing) trees in the Sahel is Faidherbia albida. Thanks to its reversed phenology (the tree sheds its leaves during the rainy season), F. albida significantly contributes to maintaining crop yield through biological nitrogen fixation (BNF)[4] and a favorable micro-climate while minimizing tree–crop competition. A study on a Faidherbia albida – millet parkland system in Niger demonstrated that shade-induced reduction of soil temperatures, particularly at the time

[3] Note: not all of the mentioned functions of agroforestry are applicable to Inadougoum due to differing climatic conditions amongst other things.
[4] Nitrogen fixation is the process by which nitrogen is being converted into ammonia by bacteria. This ammonia will subsequently be used for the synthesis of plant nutrients.

of crop establishment, is critical for good millet growth (Vandenbeldt and Williams, 1992). Furthermore, the protein-rich leaves, twigs and pods of Faidherbia albida constitute a precious source of animal feed for livestock during the long dry seasons in the Sahel. This type of reversed phenology is not observed in other parkland trees such as the shea butter tree (Vitellaria paradoxa) and néré (Parkia biglobosa), which have a negative shading effect that may reduce millet yield under the tree by 50 to 80 percent in some cases (Kater et al., 1992)."

A parkland system in which F. albida is planted could all in all form a great benefit for Inadougoum. During periods of drought a micro-climate can be created which is optimized for the growth of certain crops. At the same time, the upper layer of the soil is being protected against water and wind erosion and the tree puts nutrients in the soil by means of BNF and by shedding its leaves during the wet season. The tree additionally hampers the leaching of nutrients to the groundwater. Lastly, the livestock can be fed on its leaves, twigs and pods. Of course to realize this, water is a prerequisite. We will deal with this later in this chapter.

Conditions of agroforestry

In order to make agroforestry possible in Inadougoum a few conditions have to be met. The needed work for the foundation of agroforestry and seed availability determine amongst other things the rate at which agroforestry can be applied in Inadougoum. (UNEP, 2006).

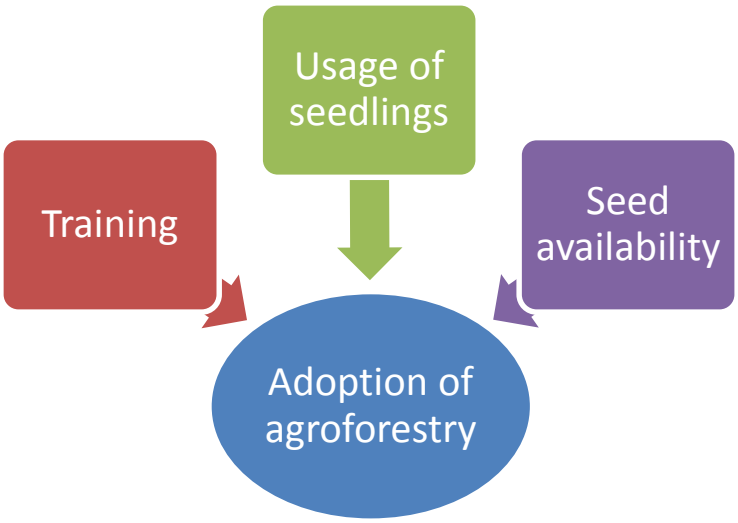

Figure 3: Conditions for the adoption of agroforestry

Firstly, an important element that influences the adoption of agroforestry is training. Since some of these agroforestry technologies may be unknown, locals will have to be educated in e.g. nursery establishment, certain planting methods, timing, tree spacing etc. As the foundation of agroforestry requires one to focus on the agricultural crops and the trees, locals may find this task overwhelmingly laborious. Therefore training programs should not only be focused on how to establish agroforestry, but also on the management of agroforestry and agriculture (UNEP, 2006).

Secondly, the usage of seedlings for planting trees for agroforestry optimizes the growth of the trees. This is because seedlings are more tolerant to certain biotic and abiotic factors than plants that are seeded directly in the beginning stages of agroforestry. In order to found seedling production, small-scale village nurseries should be used as these are managed easier than centralized nurseries. Small-scale village nurseries additionally require less work to establish and transportation costs are being diminished as well as the chances of damage as a result of handling. Due to the short growing season, the seedlings must be prepared during the periods of drought to have enough chance of being planted at the start of the wet season. This can only be done where wells or boreholes are being present, but given the fact that Inadougoum possesses a water installation this should not form a problem (UNEP, 2006).

Lastly, the restricted availability of seeds forms an obstruction in the adoption of agroforestry. UNEP (2006) mentions the following about seed availability: "The main reason why tree seeds are problematic is that, without any insurance, neither the private sector nor individual producers are ready to invest in such a highly uncertain domain. Trees may take

years before producing seeds and this can have two major consequences. Firstly, the delay in investment return may be a deterrent to many who would consider venturing into tree seed production. Secondly, adoption of successful agroforestry technologies can be stalled, because seeds are not immediately available to meet the demand. To surmount these barriers, ICRAF[5] researchers, based on experience in Kenya and Zambia, propose the 'establishment of high-quality, high-productivity seed orchards for all candidate trees in the early stages of the technology development process so that sufficient seed is available for large scale adoption by the end of the trial period' (Simons, 1996; Scherr and Franzel, 2002). Of course this strategy involves a conscious wastage of seeds from all the tree species which will not have qualified for the technology. But a trade-off analysis showed that years of foregone benefits due to unavailability of germplasm are much more costly than having to waste unwanted seeds (Scherr and Franzel, 2002). In western Kenya, ICRAF has been involving individual farmers and farmer groups in tree seed production by volunteering germplasm and information to them and agreeing to purchase seed in the first years of production (Scherr and Franzel, 2002). The new seeds are then distributed to other farmers to diffuse the technology in other areas. The same methods could be extended to the Sahel. However, it appears that a healthy collaboration between international research organisations such as ICRAF, governmental agencies and NGOs will be necessary to satisfy the increasing seed demand, which is likely to originate from a wide scale adoption of agroforestry."

What is micro-irrigation and how is micro-irrigation applicable to Inadougoum?
Mirco-irrigation (also known as drip irrigation) is an economical irrigation method that allows water to be directly delivered to the roots of plants. The amount of water that is being brought to the roots of the plants is adapted to the needs of plants. This system is interesting for Inadougoum in three ways. Firstly, the water from the village's water installation can be used economically which means that more water can be used as drink water. Secondly, micro-irrigation causes soil moisture to increase and thirdly it protects the soil against salinization. As the Luvic Arenosol contains a relatively small amount of nutrients in the upper layer of the soil, excessive irrigation and consequently salinization can make the soil completely infertile (Bulthuis, 2007; European Commission, 2010).

Method of micro-irrigation
A study of Burney, J., Woltering, L., Burke, M. et al. (2010) has shown that solar-powered micro-irrigation could increase both household income as well as nutritional intake, especially during a dry season as Inadougoum has. The European Commission (2010) says the following about solar-powered micro-irrigation:
"Promoting irrigation can reduce poverty, increase food security and help adaptation to climate change. Currently drip (or micro) irrigation is rapidly expanding in sub-Saharan Africa. Drip irrigation delivers water directly to the roots of plants which increases soil moisture. Photovoltaic (or solar) powered drip irrigation (PVDI) combines the efficiency of drip irrigation with the reliability of water pumps powered by the sun. The system uses no batteries and is self-regulating, i.e. since the sun drives both the pump speed and evaporation from plants, the volume of water pumped increases on clear hot days when plants need more water.

The research compared two villages that had installed PVDI systems with two similar villages that watered their plots by hand. The results indicated that the PVDI systems supplied, on average, 1.9 tons of produce per month. Villages without PVDI appeared to produce much less, even during the rainy season, although the researchers were unable to

[5] World Agroforestry Centre (also known as ICRAF) is a research organization that focuses on obtaining science-based information about the diverse roles trees can have in agriculture.

measure exactly how much due to food being grown in scattered home gardens. Access to food from both home production and purchasing increased dramatically for families of farmers using PVDI. The number of PVDI households under the poverty line remained the same after installation, but for the villages without PVDI there was an increase in those under the poverty line.

Consumption of vegetables increased in the villages with PVDI compared to those without. During the rainy season vegetable intake increased in all villages by 150g per person per day (approximately one serving) compared to the previous year. During the dry season the vegetable consumption in villages with PVDI was higher than villages without PVDI by about 500-750g per person per day (approximately 3-5 servings). The study noted that there was no 'surplus production' meaning that the area could support more PVDI systems without saturating demand. The research investigated the economic and environmental sustainability of PVDI. Although PVDI has a higher up-front cost than irrigation systems using liquid fuel pumps, the access to capital would be better if adopted by a group. With an increased demand and improved supply, PVDI costs could be driven down. The environmental sustainability will depend upon year-round access to water, but due to their emission-free status the research calculated that a garden using PVDI would save 0.86 tons of carbon emissions per year compared to a liquid-fuel alternative."

Even though solar-powered micro-irrigation seems to be ideal for Inadougoum, users must be well-trained in order to make this type of micro-irrigation viable. To ensure sustainability, users must have access to technical support. Furthermore, long-term monitoring of those who implement the project is necessary (European Commission, 2010).

Conclusion chapter 1

All in all, Inadougoum's climate is characterized by a wet season from June to September and a dry season the rest of the year. The amount of rainfall per year starkly fluctuates between 200-600 mm which makes the agricultural sector vulnerable. Furthermore, the relatively unfertile Luvic Arenosols in Inadougoum are prone to erode rapidly due to water or wind.

The farming optimization techniques that have been discussed in this chapter tackle both the problem of climate variability as well as soil erosion. Throughout the year, the planting of trees in agricultural land prevents the soil from wearing away due to water or wind. During periods of drought, parkland systems with F. albida create a favourable micro-climate and simultaneously make the soil nutrient-rich. PVDI makes sure that the water is brought directly to the roots of the crops and that soil moisture is being increased. Furthermore, PVDI does not salinize the soil. The energy for PVDI devices is obtained easily, as there is plenty of sunshine during periods of drought throughout the day. During the wet season, F. albida sheds its leaves (which add nutrients to the soil), protects the soil against water and wind erosion and against the leaching of nutrients to the groundwater.

Chapter 2 Prospective crops and a healthy diet

In this chapter we will give an explanation of minerals and vitamins that are essential for a healthy diet. We also look into several crops and whether or not these crops fit into a healthy and varied diet for the people in Inadougoum and whether these crops are suitable for agriculture in Inadougoum.

Chapter 2.1 Summary and explanation of important vitamins and minerals

Vitamin A (retinol) is good for the skin, eyes, growth and immune system. Vitamin A is involved in creating new cells and plays an important role in the growth of children. Vitamin A is mainly found in meat and liver but can be created by the human body from carotenoids like alpha-carotene and beta-carotene. Shortage of vitamin A can create skin conditions, eye problems and even blindness. (Voedingscentrum[6], 2014)

Thiamine (vitamin B1) is essential for turning carbohydrates into energy, a properly working nerve system and for the muscles. Thiamine is mainly found in vegetables, dairy products, meat and grain. A shortage of thiamine can cause psychological disorders. (Voedingscentrum, 2014)

Riboflavin (vitamin B2) is used as coenzyme for getting energy out of protein, fats and carbohydrates. Riboflavin is mainly found in dairy products and meat but can also be found in some vegetables. Riboflavin deficiency can cause skin conditions around your mouth and nose. (Voedingscentrum, 2014)

Niacin (vitamin B3) plays a role in creating fatty acids. Niacin is found in meat, grain, vegetables and fish. Shortage of niacin is very rare. (Voedingscentrum, 2014)

Pantothenic acid (vitamin B5) is needed for braking up and creating proteins and fats. Pantothenic acid is found in grain, meat, eggs, vegetables, fruit and dairy products. A shortage of pantothenic acid is rare and can cause an unpleasant feeling in the feet. (Voedingscentrum, 2014)

Pyridoxal phosphate (vitamin B6) breaks up and creates amino acids. Vitamin B6 also regulates several hormones involved in growth, the nerve system, the immune system and blood synthesis. B6 is found in eggs, meat, fish, grain, vegetables and dairy products. A shortage of pyridoxal phosphate causes a weakened immune system, damage to the nerve system and anaemia[7]. (Voedingscentrum, 2014)

Biotin (vitamin B8) is required for healthy a skin and hair it also pays a part in synthesizing fatty acids. Biotin is mainly found in eggs, liver, dairy products and nuts. A shortage of biotin can create skin conditions, anaemia and depression. (Voedingscentrum, 2014)

Folic acid (vitamin B9[8]) is essential for growth and the synthesis of white and red blood cells. Folic acid is also very important for pregnant woman. Folic acid is found in vegetables, grain, meat and dairy products, a varied diet is important in taking in enough folic acid. A higher dose of vitamin C increases the amount of folic acid taken up by the body. (Voedingscentrum, 2014)

Vitamin C (ascorbic acid) functions as antioxidant, repairing and creating tissue. Vitamin C is also involved in taking up iron and maintaining the immune system. A shortage of vitamin C slows the healing of wounds, weakens the immune system, causes internal bleeding and scurvy. Vitamin C is found in fruit and vegetables. (Voedingscentrum, 2014)

---

[6] Het Voedingscentrum is a Dutch organisation aiming to give consumers independent, scientifically supported information on healthy and sustainable food.

[7] Anaemia is a decreased amount of red blood cells, red blood cells are responsible for transporting oxygen throughout the body.

[8] Sometimes folic acid is referred to as vitamin B11

Calcium is needed for building up and maintaining strong teeth and bones it is also needed for properly functioning muscles and nerves. Calcium can be found in dairy products, nuts and vegetables. (Voedingscentrum, 2014)

Iron is used for forming haemoglobin, responsible for transporting oxygen through your blood. Symptoms of iron deficiency are pale skin, restless legs and being short of breath. (Voedingscentrum, 2014)

Magnesium is involved in metabolism, functioning of muscles, conducting impulses, protein synthesis and building up bones. Magnesium is found in grain, vegetables, meat and dairy products. Effects of Magnesium shortage are tiredness and heart dysfunction however magnesium deficiency is very rare. (Voedingscentrum, 2014)

Phosphor is involved in maintaining strong bones and the storage of energy. Phosphor deficiency is extremely rare. (Voedingscentrum, 2014)

Potassium is involved in regulating blood pressure and conducting signals via the nerve system. Potassium is found mainly in fruit and vegetables. (Voedingscentrum, 2014)

Zinc is needed for the synthesis of a great deal of proteins and enzymes. Zinc is needed for the development of tissue and a good immune system. Zinc often occurs in small amounts in a great variety of products like grain, nuts, fish, meat and dairy products. (Voedingscentrum, 2014)

Copper is involved in forming tissue, bones and hair pigment. It also plays a minor role in the immune system. Copper is found in fruit, vegetables and grain. (Voedingscentrum, 2014)

Chapter 2.2 Possible crops

Millet

Millet is a grass that can be eaten by both people and animals and has been cultivated by humans for thousands of years. Millet is well known as crop in developing countries. Millet thrives with a soil temperature in between 20°C and 33°C. This grass grows very rapid; under good conditions the plant appears five days after being sown and becomes mature within three months. Flowers appear after 40-50 days. Millet grows on varieties of soil like clay or sand. Millet is sensitive for waterlogging which stops the roots from growing properly and thus reduces the yield and quality of the plant. Millet has not got a very long critical water use period[9] and seemingly is not affected much by irrigation. Most water is used during flowering (university of Georgia, college of agricultural and environmental sciences 2012)

Millet is very nutritious it contains many B vitamins (B1, B2, B3, B9) together with large amounts of phosphor, magnesium, potassium, iron, zinc and calcium. Millet also contains essential amino acids lecithin and methionine together with a list of other amino acids. In addition Millet is free of gluten. (Golden prairie[10], 2014; USDA[11], 2014)

Cassava

For cassava the temperatures have to be above 10°C. The best temperature lies between 25°C and 30°C. The plant should not be exposed to sunlight for more than twelve hours a day, more light creates a risk of lower yields and les flowering. Cassava can stand droughts very well, it can survive droughts for two to three months. Cassava needs at least 500mm of water

[9] "Critical periods of water needs can best be defined at that time when soil moisture stress can most reduce yield in an otherwise healthy crop," Joe Kemble, horticulturist with the Alabama Cooperative Extension System, 2002.

[10] Golden prairie is one of the USA's largest producers of organic millet

[11] USDA is part of the United States department of agriculture and the national nutrient database for standard reference.

annually and can grow with as much annual water as 5000 mm. The best soil for cassava is deep sandy soils, the soils need to be deep and loose enough to allow the plant to form tubers. Cassava can grow on soil with relatively poor fertility. Cassava can do without irrigation and therefore this is rarely done however irrigation does provide higher yields. (Department of Agriculture, Forestry and Fisheries of South Africa 2010)

Cassava is a root which contains a lot of energy in the form of starch and sugars. Cassava contains little protein but is a good source of minerals such as iron, magnesium, zinc, copper and potassium. (Rudrappa 2009-2014; USDA, 2014)

Yam

The yam needs temperatures of over 20°C preferably between 25°C and 30°C, the plant cannot withstand frost. The ideal daily amount of sunlight is between 10 and 11 hours, more time will encourage vine growth instead of tuber growth. Yams need at least 800mm of water, 1000mm is better, distributed equally over the growing season. (Department of Tropical Plant & Soil Sciences University of Hawaii 2007)

Yams are high in energy. The tubers form a good source of vitamin B (B1, B2, B3, B5, B6, B9). In addition yams are extremely rich in vitamin C. The tubers also contain some vitamin A and lots of minerals. (Rudrappa 2009-2014; USDA, 2014)

Cowpea

Cowpeas do not need a nitrogen rich soil because it fixes nitrogen itself, however nitrogen fertilization or additional fixation can help growth in the early stages. (James Quinn[12] 1999) The best temperature for cowpeas is anything around 30°C, the soil needs to be warm when the peas are planted. Cowpeas are drought and water logging resistant but does need a spread out supply of water in order to grow properly. Annual rainfall can range from 400mm to 700mm. The plant needs sufficient water during the flowering stage. (Department of Agriculture, Forestry and Fisheries of South Africa 2011)

Cowpeas are rich in potassium and calcium. Cowpeas also contain iron, magnesium and phosphorous. Cowpeas contain a little bit of vitamin C and several B vitamins in low doses (B1, B2, B3). Vitamin A can also be found in cowpeas. (USDA, 2014)

Prickly pear

The prickly pear is a cactus with edible fruits. The prickly pear can withstand extremely high temperatures and needs very little water. Prickly pear is intolerant for salinized soil and waterlogging. This plant is mostly used for feeding cattle during droughts however feeding this to cattle requires man to remove the thorns either by burning or cutting the thorns of which means a lot of work for the farmers. (Feedipedia[13] 2009; ICRAF 2009)

In time of droughts the plant can be eaten by cattle for it contains a lot of water but lacks a lot of protein and minerals. Except for vitamin B2, vitamins are in very small concentration, the present minerals are also in low doses. (USDA, 2014)

Sweet potato

Sweet potato favours temperatures around 25°C. Sweet potato requires a well distributed supply of water, 750mm or more is enough. Sweet potato needs a lot of sunlight, less sunlight will cause lower yields. Sweet potato can withstand drought to some extent however does not

[12] Written by the Jefferson institute, a non-profit research centre. This publication is part of a cooperative project with several universities including Purdue University and the University of Missouri

[13] Feedipedia is a project of the French and international agricultural institutes and developments centres (INRA, CIRAD, AFZ and FAO)

tolerate water logging. The best soil is deep sandy soil with little clay. (Nedunchezhiyan 2007-2010)

Sweet potato is extremely rich in vitamin A and a very good source of vitamin C, magnesium, copper and the vitamins B1, B2, B3, B5, B6, B8 and B9. In addition to this sweet potato's also include concentrations of other important minerals such as calcium and potassium. (USDA, 2014; George Mateljan Foundation[14], 2014)

Tomato

Tomatoes need temperatures between 10°C and 35°C, the optimal temperature is between 18°C and 27°C. Water stress and temperatures over 35°C cause the fruits to become soft. Tomatoes need at least six hours of sunlight a day in order to flower. Long and dry periods of sunlight cause the fruits to dry out and crack, therefore the plants need to be shaded. Tomatoes grow on many different types of soil as long as the soil is drained properly. Too much water will cause the roots to rot. Tomatoes are somewhat resistant to salinity. (Yara) It is best for tomato plants to gain large amounts of water at irregular times, this encourages root growth. (Oklahoma State University, 2012)

Tomatoes are low in energy and fat but are a good source of vitamin C and a moderate source of B vitamins. Tomatoes are also rich in potassium but do not offer much else in sense of minerals. (USDA, 2014; Rudrappa, 2009-2014)

Paprika

The optimal temperature for paprika is around 24°C. The soil should be well-drained loamy and fertile. 800mm of rainfall or more is desirable. (FAO Rome, 2005)

Paprika is an excellent source of protein and energy. It is also rich in minerals: calcium, iron, magnesium, phosphorus and potassium. Paprika is also a very good source of vitamins B2, B3, B6 and A. (USDA, 2014)

Chapter 2.3 Conclusion of the suitability of crops

When deciding whether or not a crop is suitable we look at several things. We look into how difficult is it to grow the crop in Inadougoum and what is probably needed in order to grow the crop. We also look at the crop to see if the crop fits into a healthy and varied diet.

Millet

Millet is a grass and grows very fast, its susceptibility to waterlogging is not a problem because the water seeps away very fast. Its short grow season makes it suitable for cultivation because it can grow in the rain season, this way little irrigation will be required. Millet is also very nutritious and contains lots of energy however millet is similar to grains like sorghum. Since there is no dire need for grain because of the grain bank millet might not be the most favourable crop albeit very healthy.

Cassava

Cassava could in theory be planted in Inadougoum without irrigation if there is enough water during the wet season. But irrigation would be wise since the water washes away quickly and cassava may need water over an extended period of time despite its tolerance for droughts. The soil seems to be good for Cassava, deep sands with little fertility, fertilization is probably not needed. Cassava cannot have too much direct sunlight on a single day therefore the crops may have to be grown side by side with trees for shadow.

[14]The George Mateljan Foundation is a non-profit foundation aiming to promote healthy food.

Cassava is not healthy when looking at vitamins however the amount of energy and minerals make that cassava would fit into a good diet.

Yam

Yams require 800-1000mm of annual rainfall spread out over the season. Since this is more rain then there falls in Inadougoum, yams would need irrigation. The maximum amount of daily sunlight means that yams may also have to grow together with trees for shadow.

Yams contain relatively much energy and are a very good source of vitamins especially vitamin C. If growing yams can be realised they would fit in a healthy diet

Cowpea

The soil in Inadougoum is most likely good enough for growing Cowpeas. Cowpeas need between 400-700mm of rainfall. Therefore irrigation may not be necessary but would give a better chance at a good yield.

Cowpeas form a good source of calcium, iron, potassium and zinc however cowpeas do not offer much in sense of vitamins and energy. Cowpeas are healthy but with cowpeas alone one is not going to have a healthy diet.

Prickly pear

Prickly pear would most likely thrive in Inadougoum since it can stand the heat, droughts and small amount of rainfall.

The problem with prickly pear is that it is not very nutritious to people and its best use is for fodder which, if it is used as fodder, requires intense labour and fuel to burn the thorns. Prickly pear also has a risk of becoming a pest. (Feedipedia, prickly pear) The only positive aspect of the prickly pear is that it contains lots of vitamin C.

Sweet potato

Sweet potatoes prefer a relatively low temperature which may prove to create difficulties when growing sweet potato. Shading the crops with trees could be an option however the plants also need a lot of sunlight. Sweet potatoes would also need irrigation, the amount of rainfall simply is not enough. The soil in Inadougoum seems to be right for sweet potatoes.

Sweet potato is an excellent source of vitamin A and has a moderate amount of niacin and B6. The amount of minerals is not very good but neither is it bad. If cultivating sweet potatoes is possible, it might be worth the amount of water for irrigation because sweet potatoes contain a lot of vitamin A.

Tomato

Tomatoes will definitely need to be shaded since high temperatures and over exposure to sunlight will cause the fruits to dry up and crack. The plants will also need some form of irrigation in order to gain enough water over the course of the season. The roots rotting because of waterlogging will not likely be a problem. The only concern is that although tomatoes grow on a large variety of soils, the soil in Inadougoum might not be fertile enough which means some kind of fertilization would be necessary. The tomato plants also need to be supported by means of staking or some other method of support.

Tomatoes are a moderate source of B vitamins, vitamin A and vitamin C. Tomatoes do not offer much mineral wise nor are they rich in energy. Therefore it might be too much effort to grow tomatoes while nutritional value is not spectacular. In addition tomatoes need water, shading and additional labour staking the plants.

Paprika
The soil in Inadougoum is most likely not fertile enough to grow paprika. There also is not enough water so the crops would have to be irrigated. In addition the favoured temperature for paprika is quite low so the plants might need to be shaded.

Paprika is an extremely good source of minerals and not too bad when it comes to vitamins and energy, in addition paprika is also rich in protein. It may be worth the extra effort to create good conditions for paprika because the plant is very valuable nutrition wise.

Chapter 2.4 Conclusion most suitable crop

The most suitable crops are millet and paprika because these crops are rich in protein, energy, vitamins and minerals. It is hard to say if paprika is possible for cultivation due to its requirements in fertile soil, low temperature and water. Millet most likely does not form problems when trying to cultivate it.

Cassava, yams, cow peas and sweet potatoes are good when consumed together. What one of the crops lacks in nutritious value, the other fill in.

Prickly pear and tomato are not very good choices for crops. These crops are not very nutritious. Prickly pear is labour intensive and risky due to its tendency to become a pest. Tomato also needs a lot of labour and resources that could better be used growing other crops such as paprika.

In the enclosure you will find all tables with nutrient data from USDA, 2014.

Chapter 3 Business plan for an ecological market garden in Inadougoum, Niger

In this business plan we will offer information about the idea, the goal and the organisation. We will also propose a way to govern the market garden. This proposal is based on information we received from the foundation, from experts that we have consulted and other information from websites and books.

Situation in Inadougoum

The village of Inadougoum lies in the middle of the Sahel Desert, about 80 km from Tahoua, which is the nearest city. The 900-km2 area surrounding the village consists of ten village communities. Around 10,000 people live there (there are four different groups, the Tuareg, Hausa, Fulani and Wodaabe) with 50,000 heads of cattle. They have no access to public utilities.

The foundation Aman-Iman was established to improve the quality of life for the people of Inadougoum. The foundation was created by Abakoula Argalaless, he grew up in Inadougoum and, after a remarkable personal story, he came to the Netherlands where he established Aman-Iman.

The foundation has managed to supply clean water for the inhabitants and their cattle by building a water system. The water system also enables other public utilities like hospitals and schools. The foundation would also like to explore the possibility of creating market gardens.

The foundation helped built a granary. Since the building of the granary, the village has not had to contend with any major famines. Farmers can store their seeds safely in the granary and locals can buy grains for a stable price. Currently the foundation would like to create market gardens in and around the village to improve the variety of people's diets. The yield from these market gardens will go directly to the people of Inadougoum. Through the realization of access to clean water, education, sanitation, agriculture, market gardens and sustainable development, Aman-Iman wants to improve life expectancy and the standard of living, in particular for women and children in the Tchintabaradan region (the region in which the village of Inadougoum lies).[15]

The idea in a nutshell

To create a sustainable, ecological garden that provides a high yield of nutritious crops for the people of Inadougoum.

Targets

What is the target population?

There are 10,000 people living in and around Inadougoum, there are ten rural communities. Of course, as the garden develops it can't feed all of them, but initially it's the foundations goal to feed all 10,000 people of Inadougoum.

When must everything be achieved?

[15] Source: the Aman-Iman foundation

The foundation aims to start the garden project in 2014.

Chapter 3.1 Swot (strengths and weaknesses) analysis

Strengths	Weaknesses
- The people of Inadougoum have time to work on the garden (if they are available) - The people of Inadougoum are determined to create better conditions for themselves and their children - The foundation Aman-Iman is very driven to help the people of Inadougoum and is more than willing to offer help	- Not much experience with starting a business
Opportunities	Threats
- No competition - 2 hectares of land available	Unpredictable weather: - The extreme drought that Inadougoum has to deal with. - The limited supply of water - Three months of severe rain which can destroy young plants

Chapter 3.2 Organization description, to cooperate or not to cooperate?

The foundation Aman-Iman required information about co-operatives in developing countries. Because the people of Inadougoum have time, the idea was to let them work in the garden so they can grow their own crops and divide them to the community.

What is a co-operative?

A cooperative is an independent company owned and controlled by those who use it. The goal of a co-operative is to provide long term goods and services to its member or its community. A 'normal' public company's goal is to make a maximum profit, whereas a co-operative has a more sustainable, often less risky, long term approach on providing for its community. In Inadougoum's case, the goal is to provide a more varied diet for the people of Inadougoum, by having a market garden. The goal of the cooperation would be to provide a long term, sustainable supply of crops, making profit is not a goal, but it is used as a tool to ensure the persistence of the cooperation.

Advantages:

- Benefits of scale: a large group of members collaborates to achieve a goal; they share the means of production that are needed. It's not necessary for every individual to invest in their own means of production; it's more profitable and sustainable to share.
- Flexibility in statutes: a cooperative is owned and controlled by those who use it, therefore it's flexible to a great extent. The members of a co-operative experience every

asset of the co-operative and can make great estimations for what the co-operative needs, whereas a public company is ruled from 'above' by managers or bosses.
- The co-operative decides what the profit is used for
- The entry and exit of members is simple; by joining the assembly of members and by cancelling the membership.
- Members don't have to pay any partnership or dividend taxes (of course this could differ if the rules in Niger are different).
- The checks and balances of the co-operative make for a sustainable operation. The members of a co-operative are assumed to have an involved attitude. The common goal of the co-operative is the most important goal and overrules the individual goal.

Disadvantages:

- Because the co-operative is owned and controlled by its members, there has to be a democratic governance process, this can take time as everyone's input is important.
- The individual goal doesn't always rhyme with the common goal. [16] (This will be thoroughly explained later on)

Does a co-operative suit this organisation?

Of course it's important to know if a co-operative really suits this organisation. According to the Netherlands Institute for Co-operative Entrepreneurship there are a few questions to answer that determine whether a co-operative suits this organisation.

<u>Is there a chance to develop something valuable for a particular group?</u>

Yes, the government has offered 2 hectares of land to create a market garden. Farming in the Sahel desert is difficult but certainly not impossible. Creating a market garden for the people of Inadougoum will provide more variety in their diets and as a result of that a better health.

<u>Is there a group of people that would like to take this chance to create something valuable?</u>

Yes, the idea was for the people of Inadougoum to work on the garden and divide the crops. These people would be working for a common goal from which they all can benefit.

<u>Is there commitment and dedication to achieve this goal?</u>

Yes, the people of Inadougoum and the foundation Aman-Iman will work together to create these market gardens. The foundation will offer guidance and knowledge.

All of these questions are answered with a yes. This means that a co-operative could be a suitable form of organisation. A co-operative is an organisation of voluntary members, who cooperate for their mutual, social, cultural and economic benefit. The members have collective responsibilities and common participation in entrepreneurship. [17]

[16] According to the Dutch chamber of co-operatives
[17] Netherlands Institute for Co-operative Entrepreneurship

Chapter 3.3 Keys point for setting up a successful co-operative

Develop a sense of trust:

At the core of a co-operative lies trust. Trusting one another is the base of working together in a co-operative. Every employer is working for one common goal. A co-operative is formed to achieve a common wish or goal. In this case the goal is to provide a more varied diet for the people of Inadougoum; the employers are also residents of Inadougoum so they are working together for their own community.

Even though there is a common goal, tension can build between the collective interest and the individual interest. This is when trust in the co-operative becomes crucial, to keep the team spirit intact. To create this sense of trust it's important to have a good structure.

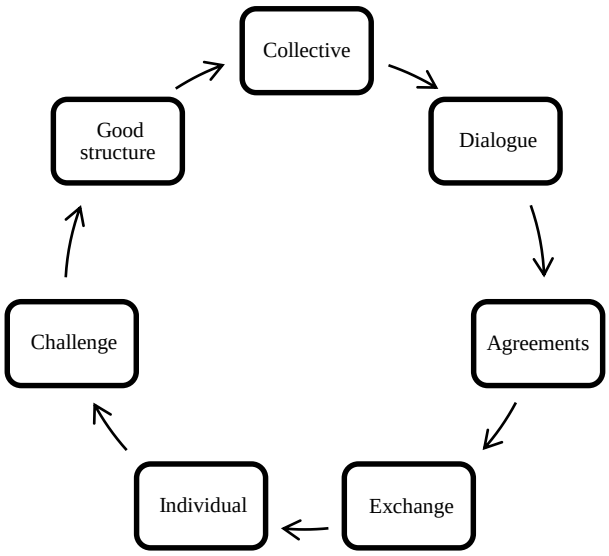

Figure 1: This is a simple model to show how a conflict can start and how it can be resolved by having a good structure.

Illustration: From the sense of a collective goal a dialogue starts to look for common agreements. These agreements are exchanged with the individual. When the individual discovers his or her own interests and advantages (which don't always agree with the collective goal) the challenge arises. To make the differences from the individual match the collective goal again, a good structure is needed.[18]

How does one set up a good structure for a co-operative?

- Determine tasks of each individual

Good governance means that the tasks of each individual is established and agreed upon. There are various tasks that have to be fulfilled.

- There have to be administrative and commission members, at least one of these members should be a part of the local board. These members will be focussed on the general interest of the market garden; especially when it comes to finances. These members will have to consider what they will do with the (potential) profit; this profit can be used to support the community, by educating the children for example. At a later stage the members might have to deal with a surplus, they will have to consider opening a small store or trading the production with other villages.

[18] Foundation ''Doen''

- There will have to be executive employers. Those who will look after the garden, plant, maintain and harvest the crops.

Both types of employers might need some type of training or assistance. Of course these two types of employers can be combined; one can be a commission member and also work on the garden.

- Set up rules for dismissal of employers

If one employer doesn't fulfil his or her task, the co-operative should have the ability to dismiss this employer. This creates a sense of responsibility and consequence. It's important to establish rules about this kind of dismissal as to prevent misunderstanding.

- Choose an appropriate business model

There are multiple business models available for co-operatives; these are the four most common ones;

- Entrepreneurs co-operative: aimed at high fares or more work
- Purchase co-operative: aimed at discounts through low purchase prices
- Investment co-operative: aimed at making more profit
- Region co-operative: turnover stays in a certain area

A region co-operative seems like the best option for the market garden. The turnover will stay in the region and will be used to develop the region. The members will decide about the collective expenses, which can benefit the area.
It's also crucial to determine the goal of the cooperation. There are four general goals for a business:

- Maximum total profit: the business aims to make as much profit as possible. The profit can be used to reinvest in the company or for an entrepreneurs private expenses.
- Minimum cost price: the business aims to produce with the lowest cost price. This way a company can ensure low selling prices, making the product affordable for a larger group of people. The risk of building up high supplies is lower, because the product is relatively 'cheap', so people will buy more. High supplies can lead to high storage costs and in Inadougoum's case: rotting of the crops.
- Maximum turnover: the business aims to get as much turnover as possible. The business will receive more brand recognition and also more customers.
- Maximum take-off: the business aims to produce as much as possible. A business will choose this goal if it wants to ensure the availability of a product or service.

In the case of the market garden striving for maximum take-off is advisable, considering that the goal is to feed 10,000 people. Maximum take-off could be the main goal but striving for a minimum cost price could also have its advantages, as it ensures that the crops will be available at an affordable price.

- Creating a proper balance between input and earnings

In a co-operative, it is important to reward every value someone brings. This prevents free-riding behaviour and guarantees that work will be rewarded, which will stimulate the members. As a result of this, those who do more, get more.

- Set up a proper fiscal and legal structure

For co-operatives, specific fiscal rules apply. These rules vary in every country. In addition, you can arrange all sorts of events in statutes and conditions that you compose together. Here you can make arrangements regarding control, ownership and profit sharing.[19]

- Set up a plan of approach for the business

In this plan of approach you determine the work activities, the tasks, furlough agreements, the time schedules of each employer and other practical agreements. This is an important step; it provides clarity and structure for the employers.

- Set up a logistic plan to divide the take off

Once the market garden is providing its first crops, the question arises of how to get these crops to the people of Inadougoum. It's helpful to create a proper logistic plan before that time comes. It might be necessary to open up a little store; this could simply be the same place where the crops are stored. Having a transport car or some wheelbarrows is probably advisable too.

Chapter 3.4 Experiences with co-operatives in developing areas

Below you will find some different experiences with co-operatives in developing areas. Frans Nijnens is an expert on product and market development and he will tell about his experience.

The example of the Mondragon co-operative business could be fitting because the area where it is established has long been undeveloped and also terrorized by bombings. It's a great example for how a co-operative can stimulate solidarity and provide a sustainable working environment.

Frans Nijnens on co-operatives in developing countries:

For illustration purposes we have asked Frans A.M Nijnens, an expert on product and market development, about his experience with co-operatives in developing areas:

''A cooperative is one the most effective and simple organization structures in developing countries. Members of cooperatives can be men of women or both, but the ones I have seen operating consisted mostly of women. Cooperatives are found in many countries, especially in Africa, and focus on production, agriculture, hospitality (hostels and restaurants, souvenir production, knitting or sewing of clothes etc.

The cooperatives I have visited in Senegal were women-only and were producing agricultural products, especially extracts of plants etc that can be used in semi-pharmaceutical products or in cosmetics and soaps (my specialization). In Burkina Faso I worked with one cooperative

[19] Netherlands Institute for Co-operative Entrepreneurship

consisting of only women who produced vegetable oils such as coconut oil and palm oil. The other cooperative consisted of physically handicapped people, mostly men, who did not produce vegetable oils, but made simple so-called boiled soaps from the vegetable oils they bought and sold them, in their wheel chairs, door to door.

All of these cooperatives were quite successful, with the exception of the handicapped group, as their customers took advantage of the handicaps and cheated by not paying or paying a much lower than requested selling price.

The big advantage of a cooperative is that all income goes to the members of the cooperative and is either equally divided or divided according to the time and energy each member devotes to the cooperative. Quite often the members have an agreement that a certain percentage of the cooperative income will be devoted to the education of the kids in the village or to some kind of medical support for all members.

The only disadvantage I can think of is disagreement among the members of the cooperation: if these is no common view or agreed "business plan" the cooperative will fail because there is not one leader (like in a regular commercial organization) who will take the final decision. Social control or peer pressure usually prevents too much disagreement and all will more or less vote for the same steps to take.'' Frans A.M Nijnens

The co-operative miracle of the Basque-country:

The economic crisis is taking its toll on the world; the neo-liberal model is being harshly criticized and seems to be failing. But if the neo-liberal model is failing, what do we turn to? According to the VN it's time for the era of the cooperative. Governments and economics are hastily trying to find a proper economic model, which can compete internationally and have the right conditions. In a documentary from the Dutch film-makers ''Tegenlicht'', Mondragon is observed. Mondragon is a co-operative established in the Spanish Basque countryside. The Basque region has long been a place to avoid; it was terrorized with bombings from the Basque liberation front. They have managed to create a social co-operative system in a hostile environment, where the postwar capitalism was the standard. ''We share everything and that's how the miracle occurs: there is enough for everyone.'' Mondragon serves as a great example of how a co-operative system should work, as a result of this it's being flooded with international visitors.

Below you will find some meaningful quotes about working in a co-operative. The quotes are from members or supporters of the Mondragon co-operative business:

''We all invested our own capital here, to become a partner you have to invest money. That investment is a part of the house, we make a living of it, and we can't just let it bleed to death. It's different from a capitalistic system, where the owner decides everything and leaves if things don't work out.''

''If you work in a cooperation, you have a job for life. You will always work for the benefit of the community. A cooperation movement makes people involved with their work.''

‘’The people of the Spanish Basque country have suffered from bombings of the Basque liberation front; it has long been a place to avoid. The people now feel a desire to take matters into their own hands. They long for freedom and economic independence, which underlies the cooperation system. The members of the cooperation don’t want to be passive objects of their destiny, they want to take matters into their own hands.’’

‘’All the new co-operatives had the solidarity genes in their system, the fact that 90% of the profit is re-invested in the business guarantees a safe future.’’

‘’A capitalistic company can move to another country, they could leave and not invest in Europe anymore, because it’s no longer profitable. Their solution would be to leave Europe, and start over in China, Africa or Eastern Europe, we (the co-operative) can’t do that, we are the owners. Capital doesn’t have a homeland, it has no borders, we (the co-operative) do have a homeland, I was born here and I want to stay here. If business isn’t going well, there will always be problems. But thanks to our maturity and our co-operative system, people will be patient and understanding, and we will get through the downfall.’’

‘’The co-operative is like a house, a large house that belongs to everybody. So we have to defend it right? With all our powers. If business is going well, the people can benefit from it, they get to share the profit. But if it’s not going well, we all have to make concessions, that’s the way a co-operative works.’’

Chapter 3.5 Resources

The foundation has multiple ways of fundraising:

- Sponsorship by companies, institutions and individuals
- Campaigns
- Writing an email to people from the mailing list
- Providing information
- Publicity
- Through our website
- Newsletters[20]

Chapter 3.6 Investment budget and financial balance

In the section; investment budget, you decide what you need to invest in to start the business. Below I have given some examples for what the market garden might need.

Fixed assets:

Fixed assets are the means of production that can be used for a longer period of time.

Immaterial fixed assets:

[20] Foundation Aman-Iman

These are sustainable means of production that are not touchable, for example the cost you make for researching and developing your business.

Material fixed assets:

- Land
- Structural requirements
- Inventory
- Machines and tools
- Transport equipment
- Remaining sustainable assets

Floating assets:

Floating assets are the means of production that can only be used once; stocks are an example of this. After usage the capital that has been invested in these means of production can be released; capital is released when trading stocks are being sold. This capital can be used to invest again. Below I have given an example for what these floating assets might be.

- Stocks; stocks can build up in various stages of production. It could be difficult to determine how big or small these stocks should be. In the case of the market garden, where the goal is to produce enough to feed the community, it is important to know what the demand of the community is. The stocks can't be too big, because the crops might decay.
- Debtors; debtors are customers who have already received the crops, but who have not paid yet. You write down the advanced payments that you have made here.
- Liquid assets; this is the cash that you can use directly
- Remaining floating assets

The total sum of the floating and the fixed assets gives you an idea how much capital is needed to start the project. The next question that arises is: how can we finance these costs?
To figure this out and to make things clear it's a good idea to make up a balance of your financial situation. This balance traditionally shows a survey of the capital, the property and the debts a business has. In the right column the assets and possessions are written down and in the left column the liabilities, the capital and the debts are shown.
Basically in the right column you write down all the assets that you need to start the project and in the left column you describe the capital that is needed to finance these assets.
Below I will give an example of what a traditional finance balance looks like:[21]

[21] From idea to business plan, drs. C van der Meer

Debt		Credit	
Fixed assets	€ 100,00	Capital	€ 600
Floating assets	€ 230,00	Long-term borrowed capital	€ 150
Liquid assets	€ 400,00	Short-term borrowed capital	€ 200
Total	€ 730	Total	€ 950

Chapter 3.7 Exploitation budgetary

In addition to determining the investment budget and the financial balance, it's important to determine what the costs and income of the business could be. These expectations are laid out in the exploitation budgetary, a prognosis of the expected costs and income in a certain period of time (usually about a year). It's important to note that the total income is the money you receive for a product or service and cost is the total amount of money you spend for sacrificing resources. I will illustrate this with an example: when the company decides to buy tools, the price you pay when you receive them are the costs, but the costs are spread over the total period that you get to use these tools, so not just for the day that you receive them. So let's say you get to use these tools for ten years, the tools will be paid with the income that you receive in these ten years, and not just the income that you made on that day.
Below I will give an example of exploitation budgetary.

Exploitation budgetary:
Turnover
-/- Purchasing value turnover
Gross profit
-/- General costs -/- Personal costs -/- Transportation costs -/- Other costs = Business income before deduction of interest and taxes
-/- Interests cost
= Business income before tax deduction
-/- Taxes
= Net business profit

The *turnover* is the amount of sold quantities multiplied by the price of the product. The *purchasing value turnover* is the amount of money you spend to realize the concerning turnover, for example; raw materials, services and other goods.
When you deduct the purchasing value turnover from the turnover you get the *gross profit*. To get the net business profit, you have to deduct the costs, the interest and the taxes from the gross profit.

If determining the exploitation budgetary is difficult, because the conditions are unpredictable, it's advisable to make exploitation budgetary for three scenarios.

1. The base case scenario; here you insert the most likely turnover and profit prognosis.
2. The best case scenario; here you insert the turnover and profit prognosis if everything turns out right and there are no disappointments.

3. The worst case scenario: here you insert the turnover and profit prognosis if everything fails.

Making exploitation budgetary for all three scenarios ensures that you are prepared for every possible scenario.

Chapter 3.8 Liquidity prognosis

Aside from the investment budget, the financial plan and the exploitation budgetary, it's handy to make a liquidity prognosis. A liquidity prognosis shows whether you will have enough cash for the coming period of time. It's an overview receipts and expenditure that the business expects to have for a successive period of time. Below I will give an example of a liquidity prognosis, which can be filled in with the personal information of the business.

Liquidity prognosis	First quarter	Second quarter	Third quarter	Fourth quarter
Liquid assets outset				
+ Cash sales				
+ Sales on account				
-/- Purchasing costs				
-/- Personal costs				
-/- Remaining costs				
Liquid assets at the end of the term				

Closing remarks:

With this business plan, we have tried to provide basic, practical and useful information that will help the Aman-Iman foundation and of course the people of Inadougoum for setting up a proper plan of approach that will bring clarity and a structure. The business plan can be used as a hold-on and was made to be personalized with the specific, personal information that the foundation and the people of Inadougoum hold.

We wish you the best of luck and hope that, with the agricultural and irrigational information offered by my fellow students, the market garden will be a success.

Conclusion

Earlier we posed the following question: *How can the people of Inadougoum (Niger) create sustainable, ecologically sound market gardens with high yield in/near their village? And what sort of business plan would they need to form a corporative?* We will now answer this question.

In order to find the right answer we dealt with the physical dimension of Inadougoum and possible farming optimization techniques. These techniques are ecologically sound, as the techniques tackle both the problem of climate variability as well as soil erosion. Throughout the year, the planting of trees in agricultural land prevents the soil from wearing away due to water or wind. During periods of drought, parkland systems with F. Albida create a favourable micro-climate and simultaneously make the soil nutrient-rich. PVDI makes sure that the water is brought directly to the roots of the crops and that soil moisture is being increased.

In addition one can say that the techniques are sustainable, because PVDI does not salinize the soil. The energy for PVDI devices is obtained easily, as there is plenty of sunshine during periods of drought throughout the day. During the wet season, F. Albida sheds its leaves (which add nutrients to the soil), protects the soil against water and wind erosion and against the leaching of nutrients to the groundwater.

In deciding which crops are suitable for the market gardens we have looked at the nutritious value of the crops and we have looked at what the crops require in terms of ecological needs. The nutritious value of the crops is important because one of the aims of the market gardens is to foresee the people in Inadougoum of a varied diet with enough important vitamins and minerals. The requirements for growing the crops is also important since one wants as high as possible yields with as little effort and resources as possible. Given that Inadougoum has not got a lot of resources in terms of water and fertile soil this is challenging. From the crops that we have assessed, millet and cassava are the crops that require the least effort and resources and are likely to cause the leas problems when cultivated. Cowpeas and prickly pear are also fairly easy to cultivate however prickly pears do need quite some work when people want to harvest the crop. Yams and sweet potatoes require more effort, these crops definitely need irrigation and will most likely have to be grown next to trees. Paprika and tomatoes are the crops that need the most resources when looking at labour, water requirements and the probable need for fertilizer.

When we look at nutritious value, the most suitable crops are millet and paprika because these crops are rich in protein, energy, vitamins and minerals. Cassava, yams, cowpeas and sweet potatoes are decent crops when looking at nutritious value. Yams and sweet potatoes contain lots of vitamins but lack high amounts of minerals. Cassava and cowpeas on the other hand contain a lot of minerals but not much vitamins. These crops together can be part of a healthy food pattern for the people in Inadougoum. Tomatoes and prickly pear both have low amounts of minerals and except for the high amounts of vitamin C in prickly pear, both crops do not have much vitamins, protein or energy either. Taking nutritious value and growing requirements together one can conclude that millet is the best crop. Second best is paprika, which despite its relatively high requirements is a very suitable crop because of its high nutritious value. Cassava, yams, cowpeas and sweet potatoes are all suitable for cultivation and when these crops are used together they form a varied diet with enough energy, vitamins and minerals. Tomato is not a good crop simply because its nutritious value does not outweigh the effort to grow the crop. Prickly pear is not a suitable crop because the profit in terms of nutritious value is low, the harvest is lots of work and unpleasant and there is a risk of the plant becoming a pest.

Lastly, a cooperative will most likely be the best choice for the ecological market garden because of the benefits of scale and the fact that any decisions are made by the people involved; this makes the cooperative a sustainable operation. To make the cooperative a success it is important that the business has a good social and financial structure

References

Aman-Iman. (2013). *Inadougoum, Niger*. Consulted on 12 14, 2013, van Aman-Iman: http://www.aman-iman.nl/index.php/inadougoum-niger

Bulthuis, J. v. (2007). *De Geo Systeem aarde.* Utrecht/Zutphen: ThiemeMeulenhoff.

Department of Agriculture, Forestry and Fisheries of South Africa. (2010). Consulted on March 1, 2014, van Department of Agriculture, Forestry and Fisheries of South Africa: http://www.daff.gov.za/docs/Brochures/ProdGuideCassava.pdf

Dewey, L., Hanna, W., David Buntin, G., Dozier, W., Timper, P., & P. Wilson, J. (2012). *University of Georgia*. Consulted on February 28, 2014, van College of Agricultural and Environmental Sciences: http://www.caes.uga.edu/publications/pubDetail.cfm?pk_id=7172

Doen. (2013). *Masterclass coorperatie.* Consulted on February 28, 2014, van Doen.

Dreimuller, A., & Dreimuller, W. (2012). *Handboek ondernemingsplan.* Den Haag: Academic Service.

European Commission. (2010, March 25). *Solar-powered irrigation improves food security in West Africa*. Consulted on February 22, 2014, van European Comission: http://ec.europa.eu/environment/integration/research/newsalert/pdf/190na3.pdf

FAO. (2001). *Niger*. Consulted on December 14, 2013, van FAO: http://www.fao.org/ag/AGP/AGPC/doc/counprof/frenchtrad/Niger_fr/Niger_fr.htm

Feedipedia. (2011, April 21). Consulted on March 1, 2014, van Feedipedia: www.feedipedia.org/node/120

George Mateljan Foundation. (2014). *Sweet potato*. Consulted on March 1, 2014, van whsfood.org

Golden Prairie. (2014). *About Golden Prairie*. Consulted on February 28, 2014, van Golden Prairie: http://www.goldenprairieinc.com/about-golden-prairie.html

Jefferson Institute. (1999, March). Consulted on March 1, 2014, van Jefferson Institute: http://www.hort.purdue.edu/newcrop/articles/ji-cowpea.html

Kamer van Coorperatie. (2014). Consulted on February 28, 2014, van Kamer van Coorperatie: www.kamervancoorperatie.nl

Langmaed, P. (2005). *Appraisal of Diversification Opportunities.* Rome: FAO.

Mapcoordinates.net. (2013). *Google Maps - Find GPS coordinates, longitude, latitude, altitude*. Consulted on 12 26, 2013, van Mapcoordinates.net: http://www.mapcoordinates.net/en

McKinsey & Company. (2012). *McKinsey on coorperatives.* Consulted on February 28, 2014, van http://www.mckinsey.com/client_service/strategy/latest_thinking/mckinsey_on_cooperatives

Met Office. (2010). *Sahelian climate: past, current and projections.* Exeter.

Nedunchezhiyan, M., Byju, G., & K. Jata, S. (2012). *Sweet Potato Agronomy*. Consulted on March 1, 2014, van

http://www.globalsciencebooks.info/JournalsSup/images/Sample/FVCSB_6%28SI1%291-10o.pdf

Nice-nyenrode. (2014). Consulted on February 28, 2014, van Nice-nyenrode: www.nice-nyenrode.nl

Rudrappa, U. (2009-2014). Consulted on March 1, 2014, van Nutrition and You: http://www.nutrition-and-you.com/nutrition-facts-search.html; http://www.nutrition-and-you.com/cassava.html; http://www.nutrition-and-you.com/yams.html; http://www.nutrition-and-you.com/tomato.html

UNEP. (2006). *Climate Variability and Climate Change in the Sahel Region.* Consulted on 12 27, 2012, van UNEP: http://www.unep.org/Themes/Freshwater/Documents/pdf/ClimateChangeSahelCombine.pdf

University of Hawaii. (2007). Consulted on March 1, 2014, van http://www.ctahr.hawaii.edu/fb/yam/yam.htm

USDA. (2014). Consulted on March 1, 2014, van USDA: http://ndb.nal.usda.gov/

van der Meer, C. (2005). Van idee tot ondernemingsplan. Utrecht: Thiememeulenhoff.

Voedingscentrum. (2014). *Voedingscentrum*. Consulted on February 28, 2014, van www.voedingscentrum.nl/nl.aspx

VPRO. (2012, March 5). *Tegenlicht - Het wonder van Baskenland*. Consulted on February 28, 2014, van http://tegenlicht.vpro.nl/afleveringen/2011-2012/Mondragon.html

World Agroforestry Centre. (2014). *Our role in agroforestry*. Consulted on 2 21, 2014, van World Agroforestry Centre: http://www.worldagroforestry.org/about_us/our_role_in_agroforestry

Enclosure:

Tables

All tables with nutrient data come from USD, 2014

Nutrient data for: Millet, raw		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	8.67
Energy	kcal	378
Protein	g	11.02
Total lipid (fat)	g	4.22
Carbohydrate, by difference	g	72.85
Fibber, total dietary	g	8.5
Minerals		
Calcium, Ca	mg	8
Iron, Fe	mg	3.01
Magnesium, Mg	mg	114
Phosphorus, P	mg	285
Potassium, K	mg	195
Sodium, Na	mg	5
Zinc, Zn	mg	1.68
Vitamins		
Vitamin C, total ascorbic acid	mg	0.0
Thiamine	mg	0.421
Riboflavin	mg	0.290
Niacin	mg	4.720
Vitamin B-6	mg	0.384
Folate, DFE	Âµg	85
Vitamin B-12	Âµg	0.00
Vitamin A, RAE	Âµg	0
Vitamin A, IU	IU	0
Vitamin E (alpha-tocopherol)	mg	0.05
Vitamin D (D2 + D3)	Âµg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	Âµg	0.9
Lipids		
Fatty acids, total saturated	g	0.723
Fatty acids, total monounsaturated	g	0.773
Fatty acids, total polyunsaturated	g	2.134
Cholesterol	mg	0

Nutrient data for: Cassava, raw		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	59.68
Energy	kcal	160
Protein	g	1.36
Total lipid (fat)	g	0.28
Carbohydrate, by difference	g	38.06
Fibber, total dietary	g	1.8
Sugars, total	g	1.70
Minerals		
Calcium, Ca	mg	16
Iron, Fe	mg	0.27
Magnesium, Mg	mg	21
Phosphorus, P	mg	27
Potassium, K	mg	271
Sodium, Na	mg	14
Zinc, Zn	mg	0.34
Vitamins		
Vitamin C, total ascorbic acid	mg	20.6
Thiamine	mg	0.087
Riboflavin	mg	0.048
Niacin	mg	0.854
Vitamin B-6	mg	0.088
Folate, DFE	Âµg	27
Vitamin B-12	Âµg	0.00
Vitamin A, RAE	Âµg	1
Vitamin A, IU	IU	13
Vitamin E (alpha-tocopherol)	mg	0.19
Vitamin D (D2 + D3)	Âµg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	Âµg	1.9
Lipids		
Fatty acids, total saturated	g	0.074
Fatty acids, total monounsaturated	g	0.075
Fatty acids, total polyunsaturated	g	0.048
Cholesterol	mg	0

Nutrient data for: Yam, raw		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	69.60
Energy	kcal	118
Protein	g	1.53
Total lipid (fat)	g	0.17
Carbohydrate, by difference	g	27.88
Fibber, total dietary	g	4.1
Sugars, total	g	0.50
Minerals		
Calcium, Ca	mg	17
Iron, Fe	mg	0.54
Magnesium, Mg	mg	21
Phosphorus, P	mg	55
Potassium, K	mg	816
Sodium, Na	mg	9
Zinc, Zn	mg	0.24
Vitamins		
Vitamin C, total ascorbic acid	mg	17.1
Thiamine	mg	0.112
Riboflavin	mg	0.032
Niacin	mg	0.552
Vitamin B-6	mg	0.293
Folate, DFE	Âµg	23
Vitamin B-12	Âµg	0.00
Vitamin A, RAE	Âµg	7
Vitamin A, IU	IU	138
Vitamin E (alpha-tocopherol)	mg	0.35
Vitamin D (D2 + D3)	Âµg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	Âµg	2.3
Lipids		
Fatty acids, total saturated	g	0.037
Fatty acids, total monounsaturated	g	0.006
Fatty acids, total polyunsaturated	g	0.076
Cholesterol	mg	0

Nutrient data for: Cowpeas (black eyes), raw		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	77.20
Energy	kcal	90
Protein	g	2.95
Total lipid (fat)	g	0.35
Carbohydrate, by difference	g	18.83
Fibber, total dietary	g	5.0
Sugars, total	g	3.00
Minerals		
Calcium, Ca	mg	126
Iron, Fe	mg	1.10
Magnesium, Mg	mg	51
Phosphorus, P	mg	53
Potassium, K	mg	431
Sodium, Na	mg	4
Zinc, Zn	mg	1.01
Vitamins		
Vitamin C, total ascorbic acid	mg	2.5
Thiamine	mg	0.110
Riboflavin	mg	0.145
Niacin	mg	1.450
Vitamin B-6	mg	0.067
Folate, DFE	Âµg	168
Vitamin B-12	Âµg	0.00
Vitamin A, RAE	Âµg	41
Vitamin A, IU	IU	817
Vitamin D (D2 + D3)	Âµg	0.0
Vitamin D	IU	0
Lipids		
Fatty acids, total saturated	g	0.090
Fatty acids, total monounsaturated	g	0.032
Fatty acids, total polyunsaturated	g	0.150
Cholesterol	mg	0

Nutrient data for: Prickly pears, raw		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	87.55
Energy	kcal	41
Protein	g	0.73
Total lipid (fat)	g	0.51
Carbohydrate, by difference	g	9.57
Fibber, total dietary	g	3.6
Minerals		
Calcium, Ca	mg	56
Iron, Fe	mg	0.30
Magnesium, Mg	mg	85
Phosphorus, P	mg	24
Potassium, K	mg	220
Sodium, Na	mg	5
Zinc, Zn	mg	0.12
Vitamins		
Vitamin C, total ascorbic acid	mg	14.0
Thiamine	mg	0.014
Riboflavin	mg	0.060
Niacin	mg	0.460
Vitamin B-6	mg	0.060
Folate, DFE	Âµg	6
Vitamin B-12	Âµg	0.00
Vitamin A, RAE	Âµg	2
Vitamin A, IU	IU	43
Lipids		
Fatty acids, total saturated	g	0.067
Fatty acids, total monounsaturated	g	0.075
Fatty acids, total polyunsaturated	g	0.213
Cholesterol	mg	0

Nutrient data for: Sweet potato, raw, unprepared		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	77.28
Energy	kcal	86
Protein	g	1.57
Total lipid (fat)	g	0.05
Carbohydrate, by difference	g	20.12
Fibber, total dietary	g	3.0
Sugars, total	g	4.18
Minerals		
Calcium, Ca	mg	30
Iron, Fe	mg	0.61
Magnesium, Mg	mg	25
Phosphorus, P	mg	47
Potassium, K	mg	337
Sodium, Na	mg	55
Zinc, Zn	mg	0.30
Vitamins		
Vitamin C, total ascorbic acid	mg	2.4
Thiamine	mg	0.078
Riboflavin	mg	0.061
Niacin	mg	0.557
Vitamin B-6	mg	0.209
Folate, DFE	Âµg	11
Vitamin B-12	Âµg	0.00
Vitamin A, RAE	Âµg	709
Vitamin A, IU	IU	14187
Vitamin E (alpha-tocopherol)	mg	0.26
Vitamin D (D2 + D3)	Âµg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	Âµg	1.8
Lipids		
Fatty acids, total saturated	g	0.018
Fatty acids, total monounsaturated	g	0.001
Fatty acids, total polyunsaturated	g	0.014
Cholesterol	mg	0

Nutrient data for: Tomatoes, red, ripe, raw, year round average		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	94.52
Energy	kcal	18
Protein	g	0.88
Total lipid (fat)	g	0.20
Carbohydrate, by difference	g	3.89
Fibber, total dietary	g	1.2
Sugars, total	g	2.63
Minerals		
Calcium, Ca	mg	10
Iron, Fe	mg	0.27
Magnesium, Mg	mg	11
Phosphorus, P	mg	24
Potassium, K	mg	237
Sodium, Na	mg	5
Zinc, Zn	mg	0.17
Vitamins		
Vitamin C, total ascorbic acid	mg	13.7
Thiamine	mg	0.037
Riboflavin	mg	0.019
Niacin	mg	0.594
Vitamin B-6	mg	0.080
Folate, DFE	µg	15
Vitamin B-12	µg	0.00
Vitamin A, RAE	µg	42
Vitamin A, IU	IU	833
Vitamin E (alpha-tocopherol)	mg	0.54
Vitamin D (D2 + D3)	µg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	µg	7.9
Lipids		
Fatty acids, total saturated	g	0.028
Fatty acids, total monounsaturated	g	0.031
Fatty acids, total polyunsaturated	g	0.083
Cholesterol	mg	0

Nutrient data for: Spices, paprika		
Nutrient	Unit	Value per 100 g
Proximates		
Water	g	11.24
Energy	kcal	282
Protein	g	14.14
Total lipid (fat)	g	12.89
Carbohydrate, by difference	g	53.99
Fibber, total dietary	g	34.9
Sugars, total	g	10.34
Minerals		
Calcium, Ca	mg	229
Iron, Fe	mg	21.14
Magnesium, Mg	mg	178
Phosphorus, P	mg	314
Potassium, K	mg	2280
Sodium, Na	mg	68
Zinc, Zn	mg	4.33
Vitamins		
Vitamin C, total ascorbic acid	mg	0.9
Thiamine	mg	0.330
Riboflavin	mg	1.230
Niacin	mg	10.060
Vitamin B-6	mg	2.141
Folate, DFE	Âµg	49
Vitamin B-12	Âµg	0.00
Vitamin A, RAE	Âµg	2463
Vitamin A, IU	IU	49254
Vitamin E (alpha-tocopherol)	mg	29.10
Vitamin D (D2 + D3)	Âµg	0.0
Vitamin D	IU	0
Vitamin K (phylloquinone)	Âµg	80.3
Lipids		
Fatty acids, total saturated	g	2.140
Fatty acids, total monounsaturated	g	1.695
Fatty acids, total polyunsaturated	g	7.766
Fatty acids, total trans	g	0.000
Cholesterol	mg	0