Bachelor Thesis

Analysing Marketing Strategies of Agroforestry-Grown Walnuts: Lessons for the Lower Rhine Region

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Abstract

Agroforestry (AFS) could help fight climate change by sequestering carbon (Nair et al., 2021). However, few markets accurately reflect the value of agroforestry products, posing a barrier to farmers implementing AFS (Litschel et al., 2023). In addition, while AFS could i.e. help the Lower Rhine Region reduce nitrate pollution, there is little research on AFS in this region. This thesis aims to reduce these barriers to AFS in the Lower Rhine Region by developing a marketing strategy for one promising agroforestry product: walnuts (*Juglans regia*).

To do this, consumer prices of 62 walnut products from 15 stores in the Kleve area were collected over 46 days to gain an insight into the local market. Secondly, expert interviews were conducted with three German walnut producers to assess their marketing strategies. The SIVA framework (Solution, Information, Value, Access) by Dev and Schultz (2005), was used to analyse the transcripts. Then, the results were adapted to the context of the Lower Rhine Region and agroforestry to provide marketing guidelines for producers of AFS-grown walnuts in the Lower Rhine Region.

Results show that not only could new walnut producers successfully compete with imported walnuts in the Lower Rhine Region, but that agroforestry could also be a significant asset to their marketing strategy.

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AFS: agroforestry system
CSA: community supported agriculture
ES: Ecosystem services
LER: land equivalent ratio
LRR: Lower Rhine Region

1. Introduction

1.1. Problem statement

Agroforestry (AFS) has been shown to have many ecological, economic and social benefits for farms in Germany: from making farms more economically diverse (Rigueiro-Rodriguez et al., 2009), sequestering carbon (Drexler and Don, 2024), and reducing fertilizer runoff (Andrianarisoa et al., 2016) to increasing the biodiversity and the attractiveness of agroecosystems (Nair et al., 2021), to name only a few examples.

Particularly AFS potential to sequester carbon has increased recent interest: the CAP Strategic Plan already accounts for 200,000 ha of agroforestry (AFS) in Germany by 2026 to combat climate change (Umweltbundesamt, 2023). However, this goal seems unrealistic: currently, agroforestry is rare in Germany and there are many economic and social barriers to farmers implementing AFS, such as high bureaucratic hurdles, (Tsonkova et al., 2018, García de Jalón et al., 2018) and a perception of low profitability due to the long and often uncertain return on investment (Litschel et al., 2023). While profitability of AFS products could be improved through strategic marketing, there is lack of markets for agroforestry products that accurately reflect their value (Litschel et al., 2023, Sollen-Norrlin et al., 2020).

While the barriers to AFS in Germany are now fairly well-researched (Kayser, 2023a), the next step is developing solutions to these barriers. In addition, research on AFS in the Lower Rhine Region is lacking, despite growing interest from local farmers (shown i.e. in recent workshops held with the Agroforst Reallabor at Rhine-Waal University (Kayser, 2023b)). Therefore, this thesis will focus on the Lower Rhine Region and address the abovementioned lack of markets for AFS products by examining marketing strategies for one possible AFS product: walnuts (*Juglans regia*).

Walnuts are a promising AFS product for several reasons: firstly, the demand for all kinds of nuts in Germany has risen by 38% over the past 15 years (BMEL, 2023b). Secondly, walnuts are already grown in Germany (Kötter et al., 2023) and they are already part of local culinary culture (CBI, 2019), so neither climate not cultural acceptance are an issue. Thirdly, as one of the healthiest tree nuts, walnuts have high levels of unsaturated fatty acids and antioxidants, (Vinson and Cai, 2012) and are proven to be beneficial for conditions like high blood pressure and diabetes (Katz et al., 2012). As a healthy source of fat, they could be a crucial local food resource as the popularity of plant-based diets rises (forsa GmbH, 2023). Then, despite having a climate suitable for walnuts, Germany is one of the top importers of walnuts (CBI, 2019). In 2022, 64000t of walnuts (kernels and in-shell) were imported into Germany and total imports have more than doubled in the past 15 years, while inland production remained stagnant at ca. 18000t/year (FAO, 2024). Finally, walnuts are already commonly grown in AFS in temperate regions (Graves et al., 2007, Andrianarisoa et al., 2016), and the many uses of the tree make it an asset in AFS (Pontow, 2018).

Given these factors, a large market potential for AFS-grown walnuts becomes evident. Tapping this potential could encourage more farmers to adopt AFS, increasing carbon sequestration and other positive externalities in the Lower Rhine Region. However, German AFS-grown walnuts would have to compete with cheaper imported goods from Chile, the USA and France (CBI, 2019), and consumers would need to be convinced of the higher value of AFS products since the growing system is unknown among the general public (Sollen-Norrlin et al., 2020). Therefore, a marketing strategy is necessary to support farmers in the Lower Rhine Region who are interested in transitioning to AFS including walnut trees.

1.2. Research Objectives

The main research objective of the thesis is to develop a marketing strategy that could help AFS-grown walnuts from the Lower Rhine Region successfully compete with imported walnuts. To develop this marketing strategy, this thesis will be guided by the following research questions:

1. What is the current market situation for walnuts in the Lower Rhine Region?
2. What marketing strategies do walnut producers in and around the Lower Rhine Region use?
3. What can be drawn from their strategies that other producers could use to market their AFS-grown walnuts successfully?

1.3. Context within the TransRegINT project

The thesis topic was developed with support from the Agroforst Reallabor project, which is a sub-project under the TransRegINT project at Rhine Waal University. The TransRegINT project (TransRegINT: Transformation of the Lower Rhine Region - Innovation, Sustainability, Participation) acts as a connecting link between Rhine Waal University and industry partners in the region with the aim of fostering local sustainable social, economic, and ecological transformation. The TransRegINT project is supported by the German Federal Ministry of Education and Research and will run from 2023 until the end of 2027.

One project under this concept is the Agroforst Reallabor project, which aims to facilitate the adoption of more agroforestry systems in the Lower Rhine Region through scientific support, collaboration with local farmers, and knowledge transfer. This thesis topic was developed during the author's employment under the Agroforst Reallabor project as a student assistant.

1.4. Scope of thesis

Due to the context of the thesis in the Agroforst Reallabor project, this thesis will focus primarily on the Lower Rhine Region (LRR), developing a marketing strategy tailored as much as possible to the area. The region is also of interest as there is a lack of prior agroforestry-related research in the region. Most of the existing papers focusing on agroforestry in Germany have been Germany-wide, many with a focus on Brandenburg, which is very different to the LRR both socially and geographically (Litschel et al., 2023, Tsonkova et al., 2018) or the south of Germany (Hofman, 2019). Therefore, a unique regional focus should prove useful to gain more detail in the growing field of agroforestry.

However, as the number of local walnut producers is small, some interviewees were drawn from regions outside of the LRR. Their experiences will then be transferred into the LRR context and evaluated for relevancy. In addition, since some of the interviewees do not grow their walnuts in what would be legally considered AFS systems, results will first examine walnuts grown in Germany and marketed to the surrounding region. The thesis will then consider the special situation of AFS walnuts and consider the differences between locally grown walnuts and AFS walnuts specifically when developing the final marketing plan.

2. Literature Review

The literature review will go over four main fields: agroforestry, walnut production and markets, existing farm-gate marketing strategies, and the context of the Lower Rhine Region. These four thematic pillars will provide the basis for the analysis and discussion of the interviews and the resulting "Marketing Strategy for AFS-Grown walnuts in the LRR".

2.1. Definition of Agroforestry

Agroforestry is the concept of combining trees or tall shrubs with crops and/or livestock to create an agroecosystem that benefits from the interactions between these elements. Globally, there are many different definitions of agroforestry, but the two common terms in most definitions are the *integration* of a diverse group of plants and other organisms which, when combined, create beneficial *interactions* (Nair et al., 2021).

Depending on the combination of trees, crops, and livestock in an agroforestry system (AFS), one of three classifications can be made: *silvopasture* (trees and livestock), *agrisilviculture* (trees and crops) or a combination of all three, *agrosilvopasture* (Nair et al., 2021).

The combination of trees and agriculture is an age-old practice, known in many cultures both tropical and temperate. European examples of these historical AFS include the Mediterranean *dehesa,* which are complex agrosilvopastoral systems, or the German "*Streuobstwiese",* a silvopastoral system where livestock such as sheep graze in an orchard. However, much of the traditional knowledge around these systems was lost during the industrialization of agriculture, where trees were often removed from farms to for example streamline the use of heavier machinery (Nair et al., 2021), known as "Flurbereinigung" in Germany.

The term "agroforestry" was eventually formalized in North America in the late 1980s, and the concept then spread to Europe, where the European Agroforestry Federation (EURAF) was founded in 2011 (EURAF, 2024). Today, European farmers can receive subsidies for AFS under the Common Agricultural Policy (CAP), which as of 2024 defines an AFS either two or more tree rows taking up no more than 40% of the AFS area OR scattered trees at a rate of 50-200 trees/ha (Böhm, 2024). All systems should exclude trees and shrubs on the "negative list" of the CAP. Additional limitations regarding tree spacing, harvest, proximity to neighboring fields or water bodies are discussed in detail in i.e. (Böhm, 2024).

2.2. Benefits of Agroforestry

Firstly, agroforestry offers several economic benefits: the higher diversity makes farms more **economically** diverse, offering higher financial stability (Rigueiro-Rodriguez et al., 2009). By including annual crops or livestock, AFS can offer a faster return on investment than traditional forestry, while trees increase land value more effectively than the often depletory practices of conventional arable farming (Rigueiro-Rodriguez et al., 2009). Thus, AFS offers advantages over both conventional forestry and agriculture. According to Graves et al. (2007) 27% of European farmers saw the increase of farm profitability as the main benefit of AFS.

AFS can also make more efficient use of available land than monocultures. Graves et al. (2007) shows that a land-equivalent ratio tool predicts higher profitability for silvoarable systems in France (including some walnut AFS) than for the combination of equivalent monocultures. AFS can also make use of areas that are less productive, like wet or barren land (Rigueiro-Rodriguez et al., 2009). For example, several local farmers in a recent workshop in the Lower Rhine planned to use AFS on waterlogged areas or in drainage ditches (Kayser, 2023b).

Beyond economic benefits, AFS provide many **ecosystem services** (ES), (Nair et al., 2021). Most importantly, AFS can help fight climate change both directly and indirectly. Research shows that agroforestry systems can sequester carbon both in aboveground biomass and deep in the soil, (Nair et al., 2021, Rigueiro-Rodriguez et al., 2009). One study examined multiple parcels of land in temperate climates planted with walnut trees *(J. nigra/regia x nigra)* over the course of up to 30 years concluded that AFS could sequester between 1.5-4 tonnes of C/ha yearly (Hamon et al. (2009) as cited by Aertsens et al. (2013)). In addition, AFS can reduce economic pressure on natural forests, which are the most important terrestrial carbon sinks, thus indirectly contributing to more carbon sequestration (Rigueiro-Rodriguez et al., 2009). One 2024 study of hedgerows in Germany shows up to 49% more soil organic carbon could be found under hedgerows (Drexler and Don, 2024).

Another ecosystem service provided by AFS is **biodiversity**, Nair et al. (2021). With higher biodiversity than conventional agroecosystems, AFS could counteract post-industrialization biodiversity loss and thus increase **ecosystem resilience** against pests and diseases. Diverse AFS could support beneficial predators of common pests (Boinot et al., 2020). Biodiversity also offers other benefits such as preserving rare breeds and cultivars, and helps farms adapt to climate change (Nair et al., 2021).

Not only in agriculture is biodiversity a concern: monoculture forests are susceptible to pests, so reducing economic pressure on commercial forests could allow more natural forests which provide biodiverse habitats. For example: *Ips typographus* ("Fichtenborkenkäfer"), a common pest in commercial forests in North-Rhine Westphalia (MLV NRW, 2023), actually acts as an ecosystem engineer, creating more diverse habitats for endangered organisms in forests under less economic pressure like national parks (Müller et al., 2008).

Biodiverse systems also provide opportunities for beneficial interactions between organisms: (Querné et al., 2017) found that alfalfa grown in the shade of walnut trees improved its light use efficiency by 35% and that biological nitrogen fixation is actually increased in the shaded area close to the trees. Fodder from trees can also supplement dry pastures in summer and benefit the health of ruminants (Kayser, 2023), while grazing animals remove flammable undergrowth, and encourage herbaceous growth rather than shrubbery, also limiting wildfire risks (Rigueiro-Rodriguez et al., 2009, Robles et al., 2009).

AFS also support soil conservation (Rigueiro-Rodriguez et al., 2009), and improve soil water storage, (Nair et al., 2021). Wang et al. (2015) finds that a walnut-wheat alley cropping system in China improved infiltration rates in comparison to monocultures of either crop. In turn, improved infiltration rates could help reduce flooding (Nair et al., 2021). Deep-rooting trees also help reduce fertilizer runoff: for example, walnut trees were found to take up excess nitrogen not used by crops, thus reducing leaching of N, (Andrianarisoa et al., 2016). In general, trees absorb excess nutrients more completely in deeper soil layers, thus reducing nutrient leaching into nearby water sources and combating eutrophication (Rigueiro-Rodriguez et al., 2009).

Finally, AFS also contribute to **social sustainability,** increasing the resilience of the communities that surround AFS (Nair et al., 2021, Quandt et al., 2019) While such benefits have mainly been studied in connection with tropical AFS, agroforestry systems in Europe also have a long history and are considered aesthetically pleasing by many people, making them a beneficial addition to temperate agricultural landscapes as well (Rigueiro-Rodriguez et al., 2009).

2.3. Walnuts species portrait

Walnuts are the seed of the walnut tree *(Juglans ssp.),* which is in the family *Juglandaceae*, (same family as pecans). The trees are deciduous and are native to temperate and subtropical forests in Europe, Asia and the Americas. Of the 20 species of walnuts, the English walnut *(Juglans regia)* is most often cultivated, in the USA and Canada also the black walnut *(J. nigra)* or the California black walnut *(J. hindsii). J. nigra* and *J. hindsii* or their hybrids are typically used as rootstocks for their vigor and resistance to diseases like blackline or *Phytophthora* root and crown rot (Wilkinson, 2005). *J. regia* is prized for its large, sweet nuts and is cultivated today in Southern Europe, the USA, South and Southeast Asia as well as Australia and New Zealand (Wilkinson, 2005). The cultivar *Chandler* is commonly grown in the USA (CBI, 2019).

Kayser (2023b) and Crawford (2010) find that walnut trees typically have a crown diameter of 15-20m, and Kayser (2023b) recommends a tree spacing equivalent to the final crown diameter. Wilkinson (2005) notes that upright, mechanically hedged varieties may need only 6-8m of tree spacing (pg. 190).

Planting occurs in winter in a sunny site (Crawford, 2010) with rich, deep soils and no salinity (Wilkinson, 2005). Wilkinson (2005) adds that young trees should be kept moist, ideally with an irrigation system, and can be pruned in dry weather to a central leader. She adds that pruning should not occur in spring, as walnuts have a heavy sap flow. Walnuts are monoecious (self-pollinating) but benefit from additional pollinizing cultivars interspersed throughout the plantation, as occasionally pollen production and flower receptivity do not overlap on the same tree (dichogamy), (Wilkinson, 2005).

The first harvest can be as early as 4-5 years on intensively managed, grafted trees (Wilkinson, 2005), but Crawford (2010) states that it can take up to 10-15 years to develop the full crop. The walnut develops within a green hull, which cracks open when the nut inside is ripe; the walnut kernel is found within the hard shell (Wilkinson, 2005). Walnuts should be harvested from the ground within hours of falling, cleaned and then dried slowly at 20°C-36°C (Wilkinson, 2005). Once dry, in-shell walnuts could keep for as long as 2-3 years (Crawford, 2010).

Walnuts are commonly used in agroforestry systems, (Andrianarisoa et al., 2016, Wang et al., 2015), but they can also bring some drawbacks. As large, water-loving trees, their competition with crops for above and belowground resources can be strong. In addition, the compound "juglon" in walnut leaves is an allelopathic substance, meaning that it can hinder the growth of other plants. For example, allelopathy can impact alfalfa planted next to walnuts (Querné et al., 2017).

2.4. Heath benefits of walnuts

Nuts in general are a valuable source of unsaturated fats, fiber and minerals and their consumption has been linked to positive health effects such as lowered blood pressure in several studies (Fischer and Glei, 2013). The German Nutrition Association recommends eating a handful of nuts a day (DGE e.V., 2024). As vegan and vegetarian diets become more popular (forsa GmbH, 2023), healthy fats and protein from nuts will be a crucial dietary component.

Walnuts in particular have significant health benefits. Firstly, among all tree nuts, walnuts have the highest levels of essential omega 3 fatty acids, which are primarily found in fish (Petrović-Oggiano et al., 2020, Kirkpatrick, 2022), making them ideal in planted-based diets. Another study shows that consuming walnuts helps lower blood pressure without contributing to weight gain and could help reduce the risk of diabetes and cardiovascular disease (Katz et al., 2012). There is also evidence that walnuts could support brain health and fight degenerative diseases like Alzheimer's (Chauhan and Chauhan, 2020). Walnuts also are high in antioxidants (Vinson and Cai, 2012), which are anti-inflammatory and have been linked to reduced cancer risk (Fan et al., 2023).

Thus, several sources claim walnuts are a “superfood” (Fan et al., 2023). In fact, walnuts are the only nut in the European Union where the use of a label with the health claim, “Walnuts contribute to the improvement of endothelium-dependent vasodilation” is permitted (EFSA Panel on Dietetic Products and Allergies, 2011).

2.5. Lower Rhine Region context

The Lower Rhine Region is a region in the north-east of the state North-Rhein Westphalia, Germany. While it is a loosely defined cultural/political region, it is confined by the Dutch border to the east and most sources describe it as reaching to the cities Duisburg and Oberhausen in the west (Plaschke, 2007). As its name implies, the region contains the downstream section of the Rhine, and is geologically defined as the “Niederrheinisches Tiefland” (in the north) and the “Niederrheinische Bucht” (in the south) and between the Rhine and Maas rivers (Geologischer Dienst NRW, 2024). This area includes the districts of Kleve, Wesel, and Viersen. Once covered by the prehistoric North Sea, the region is now primarily flatland with low elevation and some deposits of gravel and sand left by the Rhine and Maas rivers (Geologischer Dienst NRW, 2024).

Weather and climate: Overall, the LRR has a warm climate with medium precipitation. The vegetation period is long (223 days on average from 1991 to 2009, (LANUV, 2010)). Climatological maps of Germany show that the Lower Rhine Region had medium precipitation in 2023 (between 900-1200mm/year), a high aridity index (between 40-60 RR/TM+10), 1600-1800hrs of sunshine each year (low to medium), and was among the hottest areas in Germany with an average yearly temperature at over 11°C in 2023 (Deutscher Wetterdienst, 2024). The water balance in the LRR is net negative at -99-0mm for most of the region, but by far not as extreme as in i.e. northeastern Germany (< -200mm, (Deutscher Wetterdienst, 2024)). In essence, while the LRR is becoming arid less rapidly than other parts of Germany, the region still feels the effects of increasing aridity and lack of precipitation becoming more prevalent as climate change progresses.

Soils in the LRR are generally of high quality, and heterogenous in texture. Effective rooting depth in the LRR is measured at medium to very high (5-11dm), (BGR, 2024). Average organic matter content of the soil is measured between 2-3%, with some areas in the north of LRR as high as 6-8% SOM (BGR, 2024). Average plant available water is medium to high in the summer half year (BGR, 2024). Soils range from sandy and loamy sand in the northern areas to clay loam and silty loam in the southern areas, (BGR, 2024). Soils in the LRR have high nutrient saturation due to the high inputs from livestock farming (van der Wiel et al., 2021).

These soil and climate conditions would generally be beneficial for walnuts, which thrive in deep, rich, well-drained soils and mild weather (see Walnuts species portrait). However, irrigation may be necessary in the warmer half of the year, especially when trees are young (Wilkinson, 2005).

Agriculture in the LRR: Farms in the LRR have a heavy focus on cattle production with 60 to over 80 large animal units (LAU) per ha. Pigs are also significant in the region at 20-60 LAU per ha. (LWK NRW, 2021). There is also a heavier focus on horticulture than the rest of NRW; potatoes and grain as well as greenhouse cultures are also common crops (Agrobusiness Niederrhein, 2024, LWK NRW, 2020). To support the large number of livestock, feed corn and silage crops are also commonly found on fields in the LRR (LWK NRW, 2020), and there are high inputs of manure onto the fields (van der Wiel et al., 2021).

Environmental risks: The Lower Rhine Region has an issue with nitrate pollution: much of the area is marked as polluted on the ELWAS-Web (Land NRW ©, 2024). Many of the districts in the LRR, such as Kleve, Viersen and Wesel, showed the highest total N-application per ha in all of NRW at 230-240kg N/ha (LWK NRW, 2021). In the long term, nitrate pollution can lead to eutrophication of water bodies, endangering water quality and biodiversity, something that could be combated with AFS (Rigueiro-Rodriguez et al., 2009). On the other hand, while much of central and southern Germany show expansive areas of high erosion risk, most of the LRR is marked as “very low” or “extremely low” risk for water erosion (BGR, 2024). Summer droughts have been a concern in NRW since 2018, and in 2023, the LRR was especially affected by drought and heat compared to the rest of NRW (MLV NRW, 2023).

In fact, forests around the LRR are under immense pressure: only about 25% of the trees in forests in North Rhine Westphalia have an intact crown. In the LRR, many spruce trees have been lost since 2018. While the spruce bark beetle (*Ips typographus* “Fichtenborkenkäfer”) has been an issue in recent years, its numbers have shrunk in 2023. In all of NRW, massive losses of 142.500ha of forest remain, caused by i.e. pests and the droughts occurring since 2018 (MLV NRW, 2023). Due to precipitation deficits in recent years, forest soils have become increasingly dry, especially around the Kleve area. (MLV NRW, 2023). Lasting effects of the acid-rain induced "Waldsterben" in the 1980s also remain as well as continuing eutrophication. With increasing drought and heavily stressed forests, the risk of wildfires could increase in the LRR. In NRW, 20 wildfires occurred in 2023, destroying 8ha of forests (MLV NRW, 2023).

As discussed in Benefits of Agroforestry above, agroforestry could help mitigate the risk of runoff and water pollution. As suggested by van der Wiel et al. (2021), a better balance between crop and animal production would be necessary to improve the region's nutrient balance, and the reconnection between crop and animal production found in agroforestry could be an example of such a balance. In addition, the high pressure on NRW's forests could be reduced by introducing agroforestry systems for lumber and energy wood, while silvopastoral systems could help prevent further wildfire risks as noted by Rigueiro-Rodriguez et al. (2009). This would allow forests to better fulfill their purpose as biodiversity hotspots and carbon sinks.

Rural socio-economic factors: In the LRR, there is an aging population (ALP Institut, 2021), both among potential customers and farmers. A prognosis of the LRR for 2040 projects a 5% decrease in population over the entire area due to this aging demographic (IHK Niederrhein, 2024). As found by the 2020 agricultural census, farmers in North-Rhine Westphalia are most likely over 55 and primarily male (IT NRW, 2021b). The census also found that many older farmers run small farms, of which 40% do not have a farm successor, while larger farms are more likely to have a succession plan in place. However, the number of employees on farms in NRW has gone down from 2010-2020 by 3.5%, marking a decrease in family labor and an increase in hired and seasonal employees (IT NRW, 2021b). Farms in NRW are typically still under 100ha, but they are becoming fewer and larger (IT NRW, 2021a). In short, there are fewer people working on farms in NRW, and we can expect that number to decrease significantly in future as many older farmers retire.

Agroforestry in the LRR: Currently, there is only one AFS registered on the Agroforst-Landkarte in the LRR (DeFAF e.V., 2024). However, at least 8 farms in the Lower Rhine Region who are collaborating with Hochschule Rhein-Waal have expressed intent to implement an AFS on their land or are already in the process of doing so (Kayser, 2023b). In addition, Haus Riswick (farm of the Chamber of Agriculture NRW) is planning an energy wood AFS, and Rhine-Waal University and the city of Kleve (Tiergarten) have both implemented AFS/food forests for educational and aesthetic purposes.

Economic situation for AFS: The Common Agricultural Policy of the EU was founded in 1962 and is re-evaluated every 7 years, provides EU funding to farmers and includes additional funds to support sustainable practices (European Commission, 2023). One of these practices is agroforestry, mentioned in CAP for the first time in the 2013-2020 Regulation (Mosquera-Losada et al., 2018). However, support for agroforestry in CAP has been limited measures to support tree planting were first introduced in 1992 (Mosquera-Losada et al., 2018). However, after critique for the low subsidy level by DeFAF e.V. (2022), the subsidy for AFS raised from 60€ to 200€/ha just last year in 2023, finally bringing it to a more worthwhile level for farmers (Böhm, 2024). In addition, the legal definition of AFS is more clearly defined (see Definition of Agroforestry), providing legal security to farmers and explicitly permitting, for example, the maintenance, harvest and eventual removal of AFS, which was previously not possible if the AFS fell under the definition of a protected landscape element (Landschaftselement), (Böhm, 2024). Given the improved legal framework on the one hand, and the growing support networks in the LRR (such as Agroforst Reallabor, Haus Riswick, DeFAF e.V.), one can say that the situtation for potential AFS looks positive.

2.6. Walnut market in Germany

The German market for nuts is an import market: with 648,000 tons imported to 194,000 tons exported in 2022/23 (BMEL, 2023b). Even walnuts, which could easily be grown in the German climate, are primarily imported (Kötter et al., 2023). In the last 15 years (2008-2023), nut consumption in Germany has risen by 38% (BMEL, 2023b). According to BMEL (2023a), the average nut consumption per person and year rose from 2.1 kilos in 1960/61 to 5.6 kilos in 2021/22. Consumption has been over 5 kilos per person/year since 2017. In 2020, nuts were grown on 1072ha and on 662 farms in Germany (Statistisches Bundesamt, 2024). Of those, 31 farms grew nuts on 50ha in North Rhein Westphalia, (see Figure 1).

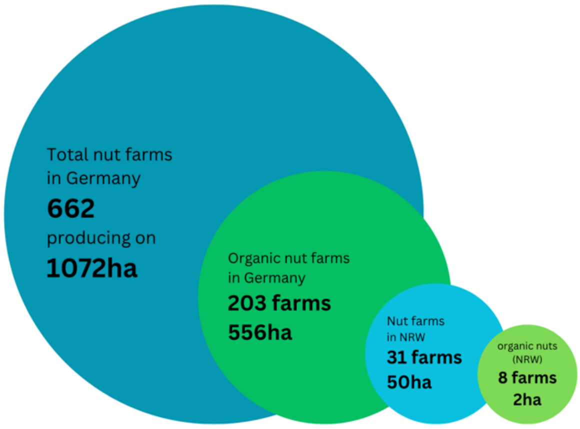

Figure 1: Walnut production Germany in 2020 (data: Stat.Bundesamt 2024; graphic: author)

Since the number of nut farms in NRW is already so small, reliable data on walnut production in the LRR remains difficult to find. The main sources of walnuts for Germany in 2022 were the United States, France, the Netherlands, and Chile (FAO, 2024). However, CBI (2019) notes that the Netherlands mainly re-export walnuts sourced elsewhere. Even for walnuts, the market is primarily saturated with imported stock Figure 2: in 2022, approx. 64000t of walnuts (shelled and unshelled) were imported into Germany (FAO, 2024). Meanwhile, German production of walnuts has stagnated around 18000t (latest available data in the FAO database was from 2017, (FAO, 2024)).

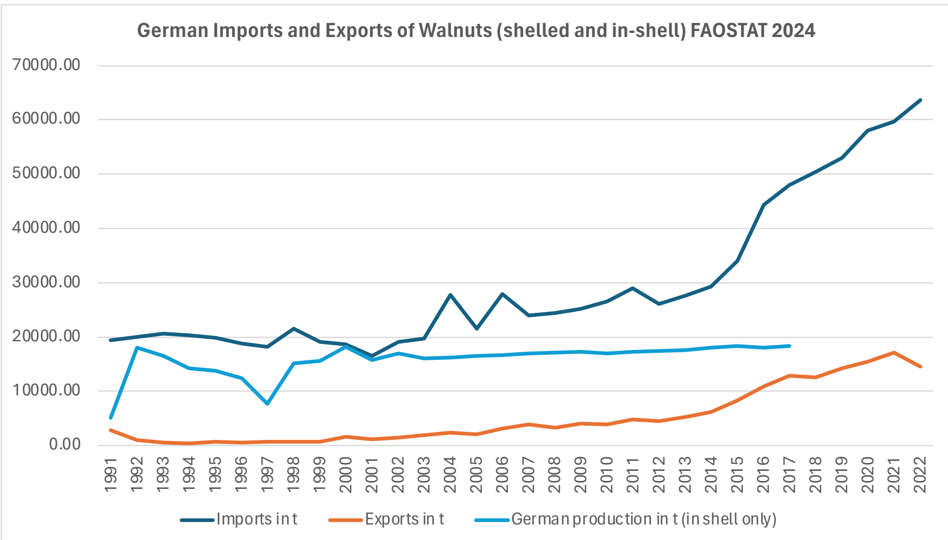

Figure 2: Total German walnut imports in tonnes, data from FAOSTAT (2024)

This shows that there is potential for German walnut producers to enter the market. However, with much more streamlined and routine processing, large exporters like the United States have the advantage of scale and efficiency, and thus also lower end-consumer prices, while processing is often more efficient in Eastern Europe, where hand-cracking results in higher quality kernels (Pontow, 2018). In general, both Pontow (2018) and the information paper by CBI (2019) find that market entry criteria to be: light colored shell and kernels, very clean shells, hand cracked and uniform (unbroken) kernels and a steady availability with less likelihood of shortages. Walnuts are also divided into classes Extra Class, Class I and Class II depending on defects and kernel size CBI (2019). A Californian walnut grower in a Galileo report adds that Germans specifically like walnuts with "broad shoulders" or that are wide enough to not roll around, and that in the walnut industry, color is generally more important than flavor (Abdallah et al., 2016). When designing a marketing strategy for agroforestry grown walnuts, these criteria will have to be considered.

Walnut kernels are typically consumed raw or roasted and can be processed into walnut butter or used in desserts and baked goods: typical uses for walnuts in Germany are in cakes, in Turkish desserts like baklava and or salads (CBI, 2019). In-shell walnuts are commonly found around Christmas as an addition to Christmas plates (CBI, 2019). More recently, walnut kernels are being used as a more sustainable replacement for exotic nuts in pesto and bread toppings in Alnatura products or cookbooks, (see i.e. Kintrup and Jansen (2021)). The local dm drugstore, as well as Prod. A, also offer walnut-infused shampoo and cosmetics. Uses for all parts of the walnut tree are detailed in the thesis by Pontow (2018).

Production of walnuts in the Lower Rhine Region is difficult to find: besides the interviewees, the LRR also includes the Vriendshof in Rees, which produces fruit and walnuts (Vriendshof, 2024). LiKK e.V. offers an oil press in the Kleve district, which can be used to press walnut oil (LIKK e.V., 2024). According to the Chamber of Agriculture NRW, there is only a few hectares of professional walnut production in North-Rhein Westphalia (LWK NRW, 2023), however, other producers that could be found in NRW include: Walnuss Manufaktur on the outskirts of Münster, which offers regional walnuts and oil pressing, (Walnuss-Manufaktur UG, 2024), Haus Nussgarten on the outskirts of Cologne (Partz, 2024), and that's nuts in Rheinhessen (that's nuts, 2024).

2.7. Farm-gate marketing of walnuts

A few main sources were used to identify key themes in modern farm-gate marketing. The following themes resulted from this analysis:

Customer focus: Both conventional marketing resources such as Kotler and Armstrong (2012) and farm-gate marketing resources, (Stephenson et al., 2019, Hurst, 2014) identify "customer focus" as their core marketing concept. This means asking who the target customer is and what their needs and desires are (Stephenson et al., 2019). These questions then form the guiding principles of not just the marketing strategy but also the initial product design. In the context of the thesis, product design in this sense is difficult, as the product is already defined: walnuts. However, "product design" can include packaging, processing, or otherwise enhancing walnuts, to better meet customer needs and desires.

One of those desires would be **values-based purchases**: Consumers purchase goods for multiple reasons, including health, a personal connection to the product, or the desire to make a statement about oneself. As Stephenson et al. (2019) puts it, "food has become a 'values-based' purchase," (pg. 107). As Dev and Schultz (2005) adds: "price-and-price alone shoppers" are in the minority. Instead, shopping for food has become more complex, with customers looking for local, sustainable, vegan or plastic free products, to name a few aspects. At the same time, Ottman (2011) argues that the "green" customer chooses these products not just to save the planet, but also based on what their sustainable choice says about them to their peers.

Among a sea of purchasing options, (especially among the import-heavy walnut market) how can farm-gate producers set themselves apart? The literature recommends two key aspects: **unified branding** and a **unique personality.**

Branding requires creating a unified image and consistently projecting that brand image ("Ultimate Small Business Marketing Guide" as cited by (Stephenson et al., 2019). This "image" means physical symbols like a logo, (which should go on all marketing materials), but also the more intangible aspects such as the farm identity (Hurst, 2014). In fact, common business-model tools like the Business Model Canvas, are designed to help find and communicate this identity (Osterwalder and Pigneur, 2010).

A **unique personality** or farm identity is a crucial marketing tool (Stephenson et al., 2019): As one farmer puts it: "compromise and do something unusual" (Renard Turner in Stephenson et al. (2019). To do this, farmers are encouraged to explore their own passions (Stephenson et al., 2019). Examples for farms in Germany that do this would be that's nuts*,* who recognize that a nut-focused business is something unusual and make this a humorous selling point on their website. Nött Tied (2024), a small producer of gluten-free nut-based muesli in Mecklenburg-Vorpommern, is an interesting example of both a unique product and personality: using local dialect to emphasize their regional focus, they tell the story of how they developed their muesli to support their own health needs on their website.

Showing their personality helps producers form stronger **customer relationships** or even a **community.** In general, resources for farm-gate marketing encourage the farmer to form a relationship with their consumer, communicating not just what makes their product good quality, but also their values, their philosophy, and their creativity. The Business Model Canvas also names customer relationships as a key point of a successful business (Osterwalder and Pigneur, 2010). One example of a classic **community** in farm-gate marketing would be a CSA (community supported agriculture), (see Beth Honiaki as quoted in Stephenson et al. (2019) pg. 112), but also the networks created by people who share interests in the same product/service: for example, the IG Nuss (2024), a club of nut producers, which is slowly building a community of people interested in regional nuts across Germany.

These communities are fostered by **clear communication.** As (Ottman, 2011) puts it: "[successful] brands engage customers with meaningful conversation". One of the main goals of the customer is to get reliable information about the product (i.e. how it functions), not just promotion or biased advertising (Dev and Schultz, 2005, Ottman, 2011). At the same time, if the product is marketed in connection to a niche topic (i.e. agroforestry), the customer must understand the issue, requiring the brand to also educate the customer (Ottman, 2011). Full transparency of information (both the good and the bad about the brand) helps improve the reputation of the farmer, in turn improving the **customer relationship**. This also goes for any middlemen: retailer reputation is equally important if not directly marketing to the consumer (Ottman, 2011).

Finally, the **function** of the product is the basis of the marketing strategy: The product must work as well or better than the competitors. "Green products" are now so highly developed that they often work better than their non-sustainable counterparts (Ottman, 2011). In farm-gate marketing this is also true: consumers buy organic products or purchase directly from farms not just to support the farmer or help the environment, but because local and sustainable products taste better, are healthier or are more unique. In short, the customer's first interest is the function of the product, then the values which it expresses (Ottman, 2011) pg 112.

3. Methodology and Conceptual Framework

3.1. Conceptual Framework: SIVA Marketing Strategy

Marketing is defined by Kotler and Armstrong (2012) as "*the process by which companies create value for customers and build strong relationships in order to capture value from customers in return*," and the marketing strategy is the logical framework by which the company achieves this goal.

The goal of this thesis is to identify a successful marketing strategy for AFS-grown walnuts in the Lower Rhine Region. Therefore, the basis of the conceptual framework for the thesis will be a marketing strategy framework. The choice falls on the "SIVA" framework from Dev and Schultz (2005), a further adaptation of the well-known 4Ps/marketing mix framework (originally attributed to Borden (1964)).

The justification for this lies in the literature review: both general resources on marketing (Kotler and Armstrong, 2012, Zikmund and Babin, 2013) and specific farm-gate/direct-marketing literature (Hurst, 2014, Stephenson et al., 2019) emphasize that the most important factor in modern marketing is a "customer-focused" strategy. A customer-focused strategy asks, “What does the customer need, and how can I design a product that meets that need?”.

While the 4Ps (Product, Promotion, Price, Place) are mentioned in both the abovementioned conventional marketing and the farm-gate marketing resources, so is an increasing need for customer-focused marketing strategies, especially in oversaturated markets, like the German walnut market. Dev and Schultz (2005) introduced the SIVA concept (Solution, Information, Value, Access) as a customer-focused update to the marketing mix concept (Borden, 1964).

Both (Dann, 2015) and Stephenson et al. (2019), find that the SIVA framework can be aligned with the 4Ps concept (Table 1).

Table 1: SIVA and the 4Ps (adapted from Stephenson, 2019) pg. 105

SIVA concept: (Dev and Schultz, 2005)	**Solution**	**Information**	**Value**	**Access**
Customer questions (Dev and Schultz, 2005)	“How can I solve my problem?”	“Where can I learn more about [the product]?”	“What is my total sacrifice to get this solution?”	“Where can I find it?”
Original 4Ps concept (Borden, 1964)	Product	Promotion	Price	Place

3.2. Market analysis methods

To gain an insight into local walnut prices, the author visited nearby stores in the Kleve area to record the prices of walnuts and searched for common walnut products on the websites of German retailers. This resulted in the Local walnut market results section. The analysis represents only a small selection of stores in Kleve and several online shops and is meant to give an initial idea of the consumer price ranges for walnut products that would be available to consumers in the Lower Rhine Region. Therefore, the author visited one of each of the different supermarkets and discounters that were nearby. Data also includes the products of the three interviewees A, B and C, since these are either available in the LRR or can be ordered online. The data collection included 62 edible walnut products from 15 different stores/online shops and was collected between the 8. March and the 22. April (46 days).

Data collected: consumer price/kg, product type, origin if applicable, organic certification, package size and type.

Stores: Aldi Süd, Alnatura (online), Biomarkt Kleve, Dm Drogerie, Edeka, koro, Lidl, Megafood, Netto, Rossmann, Seeberger (online), that's nuts, and Producers A, B and C.

Price analysis method: The weighted prices in Table 2 were calculated in Excel using the following formulas, which are adapted from Indeed (2022). The raw data and weight factors for the walnut kernel types are available in Table 7. The complete dataset on all recorded walnut products is readily available upon request from the author.

$$weighted\ avg.price\ of\ category = \frac{SUM\ (prices\ per\ kg\ of\ products\ in\ category)}{SUM\ (weight\ factors\ of\ products\ in\ category)}$$

$$weight\ factor = number\ of\ products\ in\ category\ "storetype\_product\ type"$$

3.3. Interview design

To design the interview questions and plan the analysis, methodology was drawn from two commonly used resources on expert interviews and qualitative analysis: Gläser and Laudel (2010) and Mayring (2015). Questions were developed based on the SIVA conceptual framework, the literature review as well as the interviewees' websites.

Mayring (2015) suggests the development of categories and subcategories to identify "codes" that will be later used in the analysis. Using this concept, the SIVA framework provided the initial four categories, with an additional fifth category for background information on the farm. Further subcategories were then identified based on relevant marketing literature. These were then translated into more relevant questions for the interviewees (considering Gläser and Laudel (2010)) and limiting the time of the interview to approx. 1 hour limited the number of questions as well. The interview guideline was thus adapted to each interviewee and flexibly used during the interview as permitted by Gläser and Laudel (2010) and Mayring (2015). This resulted in the variations visible in the transcripts.

In addition, the websites of all the interview partners (if available) were analyzed before the interviews according to the conceptual framework to gain an initial, unbiased insight into their marketing strategies and to avoid asking unnecessary questions. As Mayring (2015) can be used for not just expert interviews, but also to analyze any kind of content, the methodology described below applies also to the websites of the interview partners.

3.4. Interview process and transcription

Three semi-structured expert interviews were conducted with one producer in Brandenburg (Producer A) and two producers in the LRR (Producers B and C). The contacts were recommended by the advisors. Interviewees were ultimately selected based on their location in the LRR (Producers B and C) and in the case of Producer A, their expertise in walnuts and highly specialized marketing strategy. Contact was made via phone with an email follow-up. The interviews ranged from 30 minutes to an hour and were conducted digitally and the audio was recorded. The interviews were transcribed with help from the online open-source service Revoldiv, and then manually corrected, simplified, and punctuated for better understanding. The transcripts are slightly simplified, for better understanding, while preserving as much of the original dialogue as possible, as described by Gläser and Laudel (2010). The author's speech was simplified to remove interjections and retain the focus on the questions, without falsifying the original speech. Explanatory additions were added in square brackets where needed, and the names of producers and their contacts were anonymized for privacy. The resulting transcripts were then coded by hand, resulting in the codes in Figure 3:

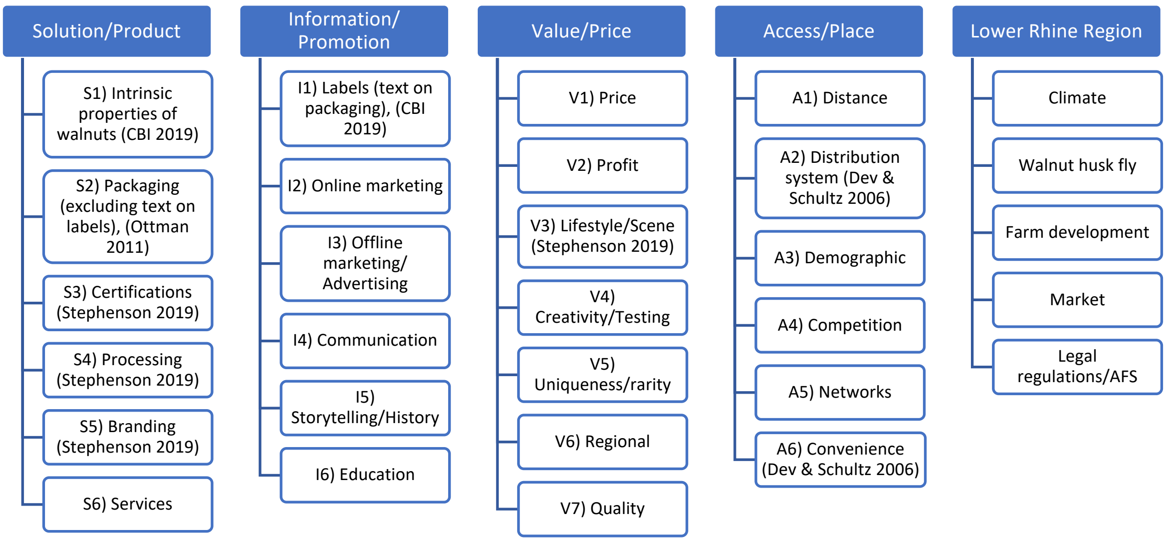

Figure 3: Final codes from the material

These codes will provide additional structure in each of the SIVA sections in the Results section.

3.5. Interview analysis

There are multiple versions of qualitative content analysis according to Mayring (2015): the main concept involves identifying "codes" in the text, which are recurring labels for qualitative data found in the material. The two main methods of coding are *inductive*, where codes are defined during and after the analysis of the text, and *deductive*, where a predefined structure of codes is created, and the material is analyzed based on this structure. Since the desired structure of the results is already known (in this case, a SIVA marketing strategy for AFS walnuts), the content of the interviews will be analyzed *deductively* (Mayring, 2015). In addition, the predetermined structure and focus on interview content, not form, mandates the choice of a *structuring content analysis,* which is a type of deductive analysis, (Mayring, 2015), see Figure 4.

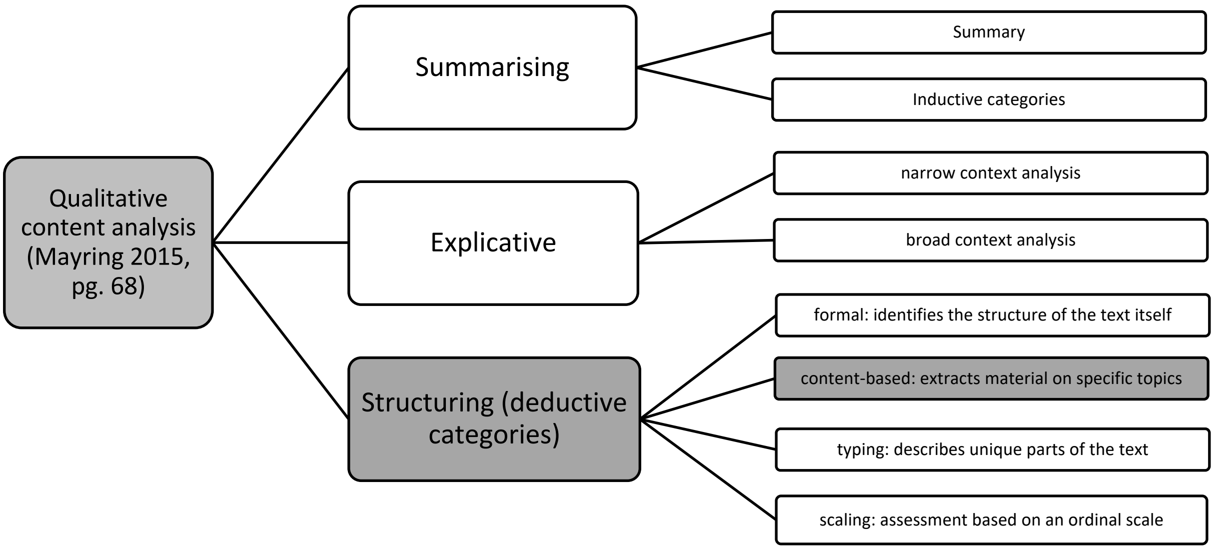

Figure 4: Qualitative content analysis types by Mayring 2015, pg. 68. Graphic by the author.

Having defined the overall structure, the second step of the process is to define subcategories and codes (Mayring, 2015). While some expected codes were defined in the interview design process, additional codes were later added that were more relevant to the material (see Figure 3). This revision is permitted by Mayring (2015), resulting in a multicyclic analysis process. The codes were selected considering marketing research and farm-gate marketing handbooks like Stephenson et al. (2019).

As detailed in Mayring (2015), the structuring analysis of the material took place as follows: after the relevant places in the text were coded, those passages were extracted and placed in the SIVA framework structure, resulting in a SIVA structure for a farm-gate marketing plan of local and sustainable walnuts.

Since the resulting coded material of the individual farms was not yet focused on AFS-grown walnuts, but for the most part on what this thesis terms "local and sustainable" walnuts, and since some farms were also outside of the LRR, the coded material was supplemented with the research context from the literature review, (and where needed, additional new research) to result in the final SIVA marketing plan for AFS walnuts in the LRR. The entire analysis process is represented in Figure 5:

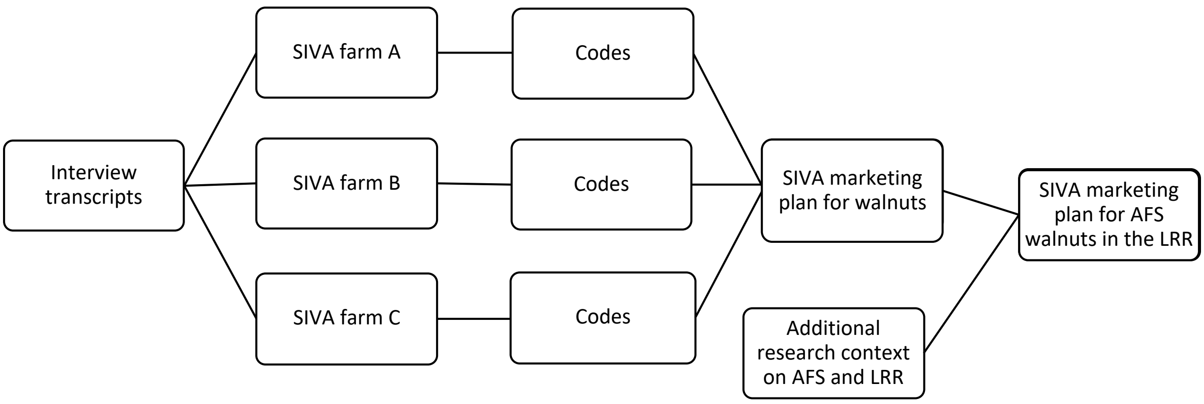

Figure 5: Analysis process diagram

3.6. Interviewee profiles

Producer A: located in Brandenburg and producing some 7 tonnes of walnuts a year, A has 200 walnut trees on 4.5ha, planted in 2015. Producer A is certified EU organic and connected to the NABU, Ökonauten and Lokalhelden. The producer states that they currently live off the farm income full-time and recently hired several part-time employees as well. Besides nut production, the producer also hosts walnut-themed events and educational seminars, with the aim of supporting other budding walnut producers in the region. (See also Table 8: Producer A: SIVA marketing strategy summary).

Producer B is a small contracting company in the Lower Rhine Region who focuses on pressing oil from walnuts. The producer processes oil, walnut butter, cakes, and liquor from ca. 100kg of walnuts from a single 50–60-year-old tree in their garden, as well as 600kg of organically certified walnuts grown in Moldavia. They also planted one *Juglans fertilis,* a dwarf walnut tree, and one tree of the cultivar *Lara.* They operate out of their family farm outbuildings and the revenue makes up about 5% of their income. They estimate that a little over 50% of their revenue stems from direct marketing of products, while the other half is from the oil pressing service. (See also

Table 9: Producer B: SIVA marketing strategy summary).

Producer C has a family farm located in the Lower Rhine Region, which is currently leased to a conventional dairy farmer. In 2016, C began selling nuts from seven old, ungrafted walnut trees to friends and family, and has since expanded to sell via a local market seller. The older trees produced about 280kg/year of walnuts in recent years, and the revenue makes up ca. 1% of their income. In 2023, the producer's daughter collaborated with Agroforst Reallabor to plant an agroforestry system on 1.8ha of land recently removed from the lease. The space between the new trees is currently planted to clover grass and will be leased to a local organic apple and sheep farmer in future. Currently, a social use concept for the new AFS is being planned, aiming for a sustainable local impact and additional income for the family. (See also Table 10: Producer C: SIVA marketing strategy summary).

3.7. Hypothesis

One challenge of the SIVA framework is worthy of note: Kotler and Armstrong (2012) (pg. 34) clearly states that the most successful marketing strategies are not product-based, but rather customer-focused, adapting products and services to meet customer needs. While agricultural businesses also benefit from this view, the long-term nature of walnut cultivation may limit the flexibility of a marketing strategy to adapt to changing customer needs, possibly necessitating a "push strategy" using a lot of advertising to push AFS-grown walnuts into the market. This hypothesis is one that will be particularly interesting to analyze.

4. Results & Marketing Guidelines

4.1. Local walnut market results

The analysis of walnut products in the Kleve area resulted in the following findings:

Solution/Product: In the Lower Rhine Region, many edible walnut products could be found (see Figure 6). Walnuts typically originated from Chile, France or California, and could be either organic or conventionally grown. Of the walnut products available in Kleve, 10 products were in-shell walnuts. Two in-shell walnut options were organic, from Edeka and Rossmann. 15 products were walnut kernels, three of these were broken walnut kernels. Five walnut kernel options were organic, from Aldi, Alnatura, dm and Biomarkt.

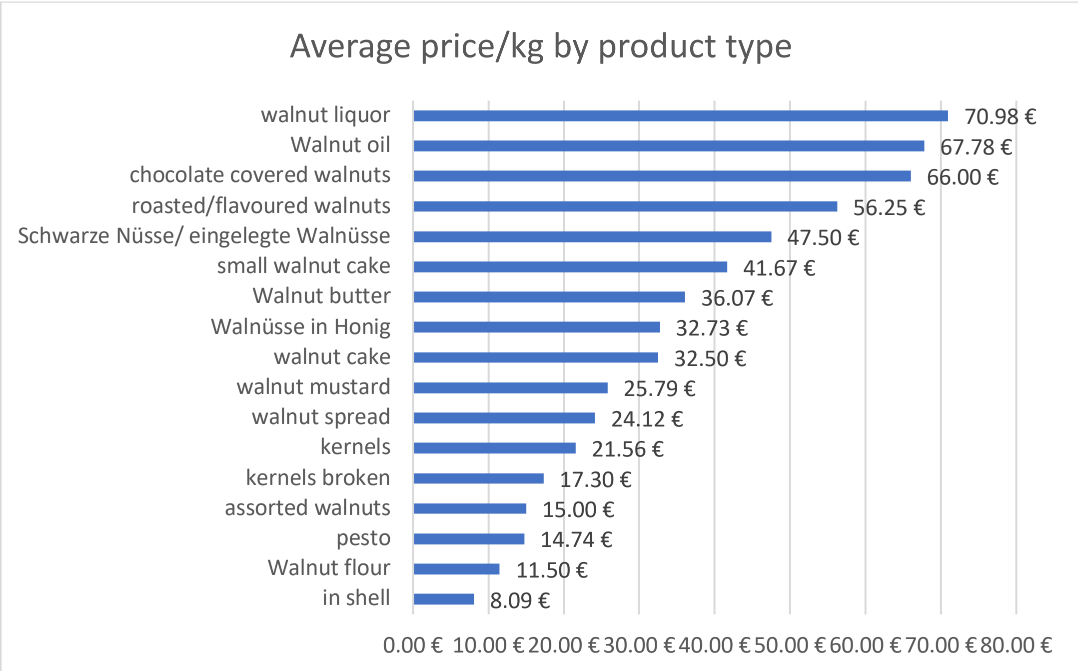

Figure 6: Average price/kg by product type in the LRR

Other products included spreads and pestos (primarily in dm and Rossman, which carry both Alnatura brands and house brands of spreads with walnuts.) The local Megafood in Kleve also carried multiple Turkish sweets with walnut kernels.

The walnut producers located in the Lower Rhine Region (including the interviewees) had a much more diverse palette of products, ranging from walnut butter and walnut flour to walnut oil and liquor. Unique specialties included walnuts in honey and green walnut preserves (also called "Schwarze Nüsse").

Packaging was normally in 150g-200g plastic bags for walnut kernels, while in-shell walnuts were normally sold in 300-500g bags or loose. Organic walnuts were sometimes sold in smaller packages, (120g-150g for kernels, two stores sold in-shell organic walnuts in 150g/300g plastic bags). Spreads, pestos, oil and liquor were generally sold in glass jars or bottles (135-140g for pestos and 100ml-200ml for oil or liquor).

Typically, these products are meant to solve customers desire for either healthy products (typically unprocessed walnut kernels or products from Rossman, dm) or for luxurious products, (chocolate covered walnuts, walnut spreads, French walnuts), and their information/promotion reflects these two solutions.

Information/Promotion: Walnuts are not heavily advertised in stores. The origin of the walnuts is often not clearly stated on the package, while some origins, like France or California, are printed on the tag or package as part of advertising. Cultivars are also rarely stated, with the exception of an Aldi package advertising “Chandler” walnut kernels from California or koro advertising “Franquette” in-shell walnuts from France. Size or class is also sometimes mentioned, such as “Jumbo, Class 1” at Seeberger or “extra large, light colored” at koro. The emphasis on origin, well-known cultivars and sizes conveys luxury and quality.

However, many packages advertise the health benefits of walnuts, such as high fiber (Koro, Rossmann), rich in Omega 3 fatty acids (Seeberger, Rossmann). Online stores typically went into more detail about the health benefits and flavour qualities of their products. Since Rossmann is known for carrying organic or healthy foods, these walnut products are most likely more targeted at the health-conscious consumers shopping at Rossmann.

Value/Price: Walnut prices vary depending on whether walnuts are organic or conventional and based on kernel type and origin. Of the walnut types, whole kernels demand the highest prices at a weighted average of 19.93€/kg (Table 2). See Table 7 in the Appendix for the corresponding raw data and weight factors.

Table 2: Weighted average price/kg by store type and kernel type in Kleve

Store type	**Raw average price by walnut type**			**Weighted avg. price/kg**
	in shell	kernels broken	kernels	
supermarket	8.15 €			**8.15 €**
discounter	6.30 €		12.44 €	**10.55 €**
drugstore	13.93 €		15.79 €	**15.41 €**
online	10.07 €	12.97 €	22.18 €	**16.21 €**
German producer	7.50 €	26.00 €	30.00 €	**12.67 €**
organic store		19.45 €	23.27 €	**20.21 €**
local producer	4.00 €		40.00 €	**22.00 €**
Weighted avg price/kg	**7.95 €**	**15.75 €**	**19.93 €**	

Total weighted average of all walnut types from all store types: 13.24€

A comparison between organic and non-organic proves surprising (Figure 7): while organic walnuts in shell are predictably more expensive than uncertified nuts, uncertified kernels are slightly more expensive than organic nuts. Presumably, this is because in the organic group, many nuts were recorded from organic house brands of discounters or drugstores, while the non-organic group included more expensive brands like Seeberger or Edeka.

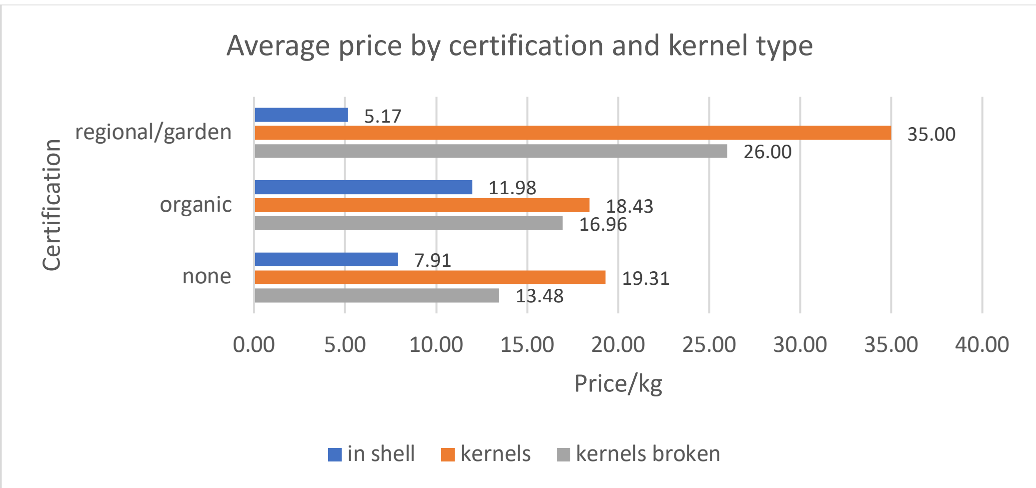

Figure 7: Average price by certification and kernel type

The certification "regional/garden" is not an official certification but was a category added to differentiate between conventional walnuts and walnuts sourced from German production or local gardens. This group includes the online shop "that's nuts" as well as walnuts from all three interviewees that were not certified organic. The extreme difference between prices for in shell and shelled walnuts in this group may reflect the effort to shell walnuts by hand as well as the low investment and maintenance costs for producers who simply inherited their trees like Prod. B+C.

In general, the sacrifice to get walnuts is low for consumers; they are conveniently located, and kernels do not need to be cracked. However, finding quality walnuts can be difficult, as the flavor of imported walnuts can taste rancid or old after standing on shelves for a long time. For example, several reviewers of walnut kernels from Aldi (Farmer Naturals) or Alnatura complain of poor flavor (Aldi Süd, 2024, Alnatura, 2024).

Access: Walnuts are very easy to access in the LRR since they are available in organic or conventional quality in almost every grocery store or drugstore. In stores, packaged walnuts are normally placed with other nuts and seeds, in-shell loose walnuts are often in the fresh fruit displays, while processed walnut products like walnut butter or spreads are close to similar products. Sometimes products are segregated by organic/conventional origin in stores as well. Cheaper walnuts are typically lower on shelves than expensive brands like Seeberger. If seeking walnuts from local or German producers, access becomes more difficult. One would have to order online from that’s nuts, or the interviewees.

4.2. Lower Rhine Region context

In the following five sections (4.2-4.6), additional structure is provided with subsections. An overview of these subsections or codes is found in the Methods section: see Figure 3. Detailed results from each of the codes are found in the SIVA profiles of each producer in the Appendix: Table 8 to Table 10.

Interviewees B+C were questioned about the feasibility of marketing walnuts in the LRR. They stated that the LRR is generally very suitable for growing and marketing walnuts. This section will inform the marketing guidelines for AFS walnuts in the rest of the analysis.

Firstly, the **climate** is generally appropriate for walnuts. Since late frosts (occurring before the 15. May) can reduce harvest, choose cultivars that are late-frost resistant and bloom later.

Interviewees also find that the soils and water levels are adequate for walnuts, although lime application and irrigation may be necessary for new plantations, finds C.

The most detrimental pest here is the **walnut husk fly,** (*Rhagoletis completa*), whose larvae attack the fruit around the walnut, turning it into a mushy brown hull and sometimes also affecting the walnut shell itself. If the mushy brown hull is not quickly removed, the walnut kernel can rot, making the nut unusable. Since *R. completa* overwinters in the soil, poor field hygiene means that the life cycle can continue the next year. To combat this, producers can use chemical control against larvae or pheromone traps to catch and detect flying adults. Fine ground nets help keep larvae from escaping the soil. However, for smaller growers, Producer B would recommend laying out a heavy building tarp during harvest season to prevent larvae from attacking fallen walnuts, and then regularly remove all walnuts and discard contaminated/infected material. A power washer can be used to easily spray off the rotten husk. If walnuts are promptly washed and dried, the walnut husk fly does not usually affect the walnut kernel, although the shell will be blackened and therefore less attractive to consumers.

Farm development was something that all the producers mentioned: they all started very small, growing step-by-step in a natural, unplanned process. While all felt that there was room for more growth in the market, B. adds that they started too late to grow their business larger, for example to cooperate with EDEKA. In addition, land prices are a challenge for producers, as B says: *"Aber wir kriegen hier kaum Acker und wenn, gehört das der RWE und die sitzt auch drauf. [...] Und mittlerweile sind die Preise für Boden schon ganz schön ordentlich."*

The **market** in the LRR is generally open for more walnut producers. All interviewees said that they could expand their market share or planned to do so. They based this on their own sales experience, the presence of imported walnuts in stores, or the success of their German competitors. Favorable factors for market receptivity include a growing interest in nutrition and health, as well as a desire for more regional products. Typical price ranges can be found in Table 2: Weighted average price/kg by store type and kernel type in Kleve.

The final category was **legal regulations around AFS**. Except for C., interviewees' walnut plantations were not planned with AFS in mind. However, for C, it was coincidence that the AFS Reallabor was started at the same time as they were planning their new plantation. However, the main benefit that they see in registering the AFS is not the higher 2024 subsidies, but the surety that the land between the tree strips can still be cultivated in future, preventing a "devaluation" of their farmland.

Interviewees were not aware of other AFS in the LRR, B. assumes it would be more common in southern Germany, feeling that people in the north are more inflexible or less interested in considering agroforestry.

4.3. SIVA marketing guidelines: Solution

Intrinsic properties: Results show that new producers would be advised to choose grafted cultivars of *J. regia* that are large, light, broad-shouldered/wide with excellent flavor and a high kernel ratio. This suits the market preferences detailed in (CBI, 2019, Pontow, 2018, Abdallah et al., 2016). Rare and attractive cultivars add interest (such as red-kernelled varieties or jumbo varieties), while producers with very little space could plant dwarf varieties such as *J. fertilis.* For specific advice on cultivars, a consult with the IG Nuss would be recommended. Owners of new plantations can purchase additional walnuts to supplement their own production (i.e. from Firma Zieler), while owners of older trees may have dark-shelled or small kernelled nuts that could be used for processing, as these are less popular in-shell. Walnuts are a common allergen, which must be marked on packaging. In addition, C finds that sufficient lime application can benefit the flavor of walnuts.

Packaging should be attractive and sustainable for direct marketing. Interviewees keep their packaging minimal, using plastic-free or paper packages or selling without packaging. In-shell walnuts are typically sold in breathable packaging like mesh bags, while processed products are best kept airtight in glass jars. Prod. C mentions vacuum-packing as an option for long storage of kernels. Packaging should be easy to reuse or recycle (for example with easily removable labels). Producers report positive feedback for minimal and reusable packaging. Since the customer base for regional walnuts is often interested in sustainability, they may appreciate such details like plastic-free or easily reuseable packaging. Some customers also clean and return jars, but while a formal jar deposit (Pfand-) system was discussed, results show that such a system is not yet common enough on the market to make it worthwhile. Seasonally themed packaging can also be used, especially when displayed on social media. When selling to retailers, it may be necessary to adapt packaging to business partners' stores.

Organic certification seems to be less necessary the closer producers are to their final consumer, but it may be required if selling to organic business partners or processors. Positive factors related to organic certification were a perception of a safer product, with better quality control and without pesticide use, especially when purchasing imported walnuts. If the land between walnut trees is to be cultivated by an organic farmer, such as in Prod. C's new plantation, a parallel certification of the whole AFS may be convenient for both parties. However, producers reports that for consumers, flavor is more important than organic certification, and so certification was primarily a question of cost-benefit for B+C. Small producers like B. may also find the paperwork and product segregation requirements for organic certification too time-consuming. Producer B was especially critical of organic associations, stating, "*Dann sind da wieder irgendwelche Institutionen, die die Hand aufhalten und ja natürlich auch gut verdienen daran. Und da habe ich nichts von.*"

Producers should therefore consider their own values and those of their future business partners and customers when weighing the cost-benefit of organic certification.

Processed products are popular with customers, especially those seeking gifts on seasonal markets. All producers engaged in some type of processing of their walnuts, ranging from drying and cracking to producing oil, walnut butter, cakes, preserves or liquor. (A list of further products with prices is found in Figure 6.) Drying can take place in trays or with an industrial ventilator, and producers find that nuts dried with cool air have a better flavor and retain their original fat structure. The next step, cracking, can be done by hand or with a cracking machine. In the district of Kleve, the LIKK (Landschaftspflege im Kreis Kleve e.V.) offers a cracking machine for loan, or producers can buy hand-cranked or engine powered crackers (B. uses the WALMAN from Obsttechnik Feucht (Obsttechnik, 2024)). Whole walnut kernels are sold raw, roasted, and seasoned, covered in chocolate, or preserved in honey. Since some customers do not like walnuts, offering spiced/candied walnuts might be an option to encourage sceptics to try them.

From the kernels, oil can be pressed. This requires an oil press, i.e. from Anton Fries Maschinenbau GmbH (2024), or the pressing service from LIKK e.V. in Kleve. The resulting walnut pomace can be sold as a vegan high protein addition to baked goods, or sold baked into cakes. B names their individual sized walnut cakes as their most popular product. These cakes are baked directly into small glasses, come in a chocolate flavor or flavored with orange liquor, and are sealed with a rubber gasket to ensure a longer shelf life.

Walnut butter can be sourced from sediments from freshly pressed oil, as Producer B does. Producer A makes walnut butter from sprouted walnuts, which are cracked, soaked in water to release the bitter substances, and then sprouted. The resulting walnut butter is described as having a unique flavor on their website, and they also emphasize that they do not heat or add anything to the walnut butter.

Other products include walnut mustard and Schwarze Nüsse/Johanninüsse, which are green walnuts preserved in syrup. For Christmas markets, seasonally themed and processed products make popular and easy gifts, drawing in new customers who happen to pass by.

Branding: Producers should ensure that their brand name reflects their focus, so that customers can find them easily. For example, all interviewees had names including “walnut” and their location and/or their services (oil pressing, offering expertise). Their logo should be attractive, relevant to their products/services, and consistent across all their marketing materials. Communicating a vibrant personality, with humour, the origin story of the farm or producers’ own motivations for growing walnuts, is popular in interviewees’ farm-gate marketing strategies and could boost the customer relationship (Stephenson et al., 2019, Ottman, 2011).

In general, the more customer-facing a producer’s marketing strategy is, the stronger branding and personality they should have. For example, A describes their self-image as down-to-earth, original, but also visionary and courageous, sentiments reflected in the informal, humorous tone of their website. Producer B has a more traditional, grandmotherly brand, with a focus on quality, taste, and forgotten recipes. However, there is a theme of community throughout their brand, from the invitations to come grind your own walnuts, to the references to their village community that evoke homely feelings in the viewer. In contrast, Producer C prefers to focus on the essentials: preserving the quality of their nuts with a professional drying process, without embellishments such as labels or logos.

Services can include cracking (A+B), pressing oil from walnuts, hazelnuts, and other soft seeds (B), a tree nursery, consultations for other walnut growers and events around the walnut like lectures, farm tours and a children's program (A). These services can help producers supplement their income from walnuts and could help finance an investment in processing machines. In the Lower Rhine region, the LIKK offers the use of an oil press and cracking machine.

Producer B, who clearly positions themselves as a service-focused business in the interview, mentions that oil pressing has a learning curve. They started by pressing oil for friends and family, and now the oil pressing makes up about half of their business. Customers pay for the pressing service and then take all the oil and byproducts back with them (10€ for the first kg, 5€/each following kg, pers. comm., 20.3.24). Customers can also use the cracking machine to crack walnuts themselves before pressing. The guidelines around Solutions are summarized in Table 3: Key takeaways for producers: Solution.

Table 3: Key takeaways for producers: Solution

Key takeaways for producers: Solution
✓ Choose cultivars of *J.regia* that are large, light, crackable, broad-shouldered and have excellent flavour. ✓ Consider diverse cultivars to add interest ✓ Can purchase additional walnuts to supplement own production ✓ Use darker, smaller walnuts for processing ✓ **Package** plastic free, in paper or without packaging ✓ In-shell: breathable packaging like mesh bags ✓ **Processed** products: airtight like glass jars ✓ Vacuum-packing for long storage of kernels ✓ Make packaging easy to reuse/recycle (removable labels) ✓ Adapt packaging to business partners' stores if needed. ✓ **Organic certification** less necessary the closer you are to your final consumer. Required if you want to sell to organic business partners or processors ✓ **Processing** can include oil, walnut butter, roasting, walnut flour, preserved walnuts, cakes, spreads/pestos...

- ✓ **Branding**: have a consistent logo and branding that reflects your main products/regional focus on websites and packaging, esp. if selling directly to consumers.
- ✓ Show your personality as part of your brand!—helps customers form a relationship with you (Stephenson et al., 2019)
- ✓ **Services** can include cracking, oil pressing, tree nurseries and events or consultations, and can help you make extra money.
- ✓ **Customers buy for function, then values:** Ensure the quality and flavour of your products is equal or better than non-regional/non-AFS competitors (CBI, 2019, Ottman, 2011).

4.4. SIVA marketing guidelines: Information

Labels should include legally required information such as nutrition contents, allergens, origin, and amounts (see (CBI, 2019) for more details). Include best-before date or date of processing**.** For resellers, labelling is less important, as C. reports. Producers typically keep labels minimal, including their name and address and their logo if applicable.

Online marketing can include a website, an online shop, and social media to increase customer traffic, improve transparency, and offer engagement. Producers should include clear and detailed information about products on their website, as interviewees tended to go well beyond the minimal requirements when describing their products online. They include recipes, descriptions of flavor and processing, or information about vegan and vegetarian status (especially interesting for increasingly planted-based and nutrition-conscious younger customers, (BMEL, 2022a). Excellent documentation is evidence of professional quality and is therefore a selling point: on their website, Prod. A describes how they document cultivar and origin of all their walnuts. Since cultivars and origins are not often included on imported walnuts in stores, this could already help local producers stand out. Websites should also consider search engine optimization and common customer questions when writing product descriptions, especially for potentially unfamiliar products.

Producers use social media to give a face to the brand: they show their farm story, the people and processing behind walnuts, as well as the products on attractive photos. Social media is also used to drive engagement: with walnut fun facts, giveaways, or dates of upcoming event or market venues. WhatsApp could be used for smaller businesses as C does, (mainly to friends and family) but would not be recommended for producers with larger customer bases, since a website and contact form is more efficient and professional.

Beyond social media, TV stations might be interested in a documentary if producers have an innovative or sustainable business model like agroforestry, a CSA, or a U-pick operation. A+B have had ProSieben and WDR make high-quality documentaries about their businesses.

Offline marketing options include word-of-mouth, signage, market stands on regional markets, roadside stands, and newspaper ads. Interviews show that producers primarily market via direct customer contact. A. states that direct customer contact is beneficial since it helps customers develop an understanding for higher local prices based on higher workload. Road stands are a simple way to begin marketing but should be either close to the farmhouse or in public view or have a vending machine to prevent stealing. B. uses newspaper ads 2-3x per year to **advertise** for oil pressing services, which makes sense given the older demographic of customers for oil pressing (see 4.6 Demographics). Based on B's experience, producers should advertise pressing services well before the harvest season begins so that customers know to store their excess walnuts instead of giving them away.

Communication with customers should always be friendly and aim to identify their needs to recommend the perfect product (consider demographics and interests like nutrition, gardening or seeking a gift). Customer feedback creates a continuous two-sided dialogue with the producer. Some producers particularly enjoy talking to customers and consider themselves marketing "types" with a particular affinity for understanding customers' needs. These producers could be especially successful at selling in their own shop or market stand.

Notably, customers also demand product of their own accord from both B and C despite them not having formal farm shops or extensive advertising, creating a "pull" effect in the market (Kotler and Armstrong, 2012). This occurs via Whatsapp or email, and C mentions that one customer asked for their walnuts even after moving out of the region, since they were unable to find such good quality.

Producers should always communicate clearly and honestly but may sometimes need to convey respectful boundaries in case of stealing, customers visiting the farm without previous appointment, or to ask for tolerance for longer wait times due to understaffing/family responsibilities. A note on the website (A+B), signage at the farm gate (C) or personal communication can help with this.

Storytelling and **education** can also be powerful parts of the marketing strategy: Producers A and B bring elements of storytelling into their marketing, describing their farms and their products with evocative language, as well as their origin story and motivations. This creates a more tangible sense of place and quality for the consumer.

Language helps communicate quality by using language like "*made with love*" "*professional quality*" "*Kreislaufprinzip*" or "*100% naturbelassen*" (A's website) or simply by describing in detail how their walnuts are grown, stored, and processed. Flavor is an important trait for quality walnuts: products are therefore described with positively connotated adjectives ("*cremig, fein, süchtig machend, himmlisch*", on A.'s website).

All three producers are conscious of the long history of walnuts, and they share this with customers. Many (older) customers have a childhood connection to the tree (as Producer C says, "*Früher hatte hier jeder Hof einen Walnussbaum, also mindestens einen.")*

Some customers may need to be **educated** on the benefits of regionality and the health benefits of walnuts. If offering pressing services, Prod. B finds that it can be necessary to educate customers to save their excess walnuts for processing instead of giving them away. When educating customers, it is often better to show rather than tell: Prod. B's demonstrations of products, processing and growing methods are powerful tools for engaging customers. Producers could also show the positive externalities of AFS in the Lower Rhine Region, like offering shade, reducing runoff, and improving aesthetics.

The guidelines around Information are summarized in <u>Table 4: Key takeaways for producers: Information.</u>

Table 4: Key takeaways for producers: Information

Key takeaways for producers: Information
✓ Legally required information: nutrition contents, allergens, origin, amounts (see (CBI, 2019) for more details. Include best-before date or date of processing ✓ For resellers, labelling is less important.

- ✓ Use a website, online shop, and social media to increase customer traffic, transparency and engagement
- ✓ Include clear and detailed information about products on website! Be honest.
- ✓ Can also add recipes, description of flavour or uses
- ✓ Use **social media** to give a face to your brand: show your farm story, the people and processing behind walnuts, as well as the products
- ✓ Use social media to create engagement: walnut fun facts, giveaways, Q&As, date of next event or market venue
- ✓ Whatsapp can be used for smaller businesses (friends and family) but would not recommend for larger customer bases (website and contact form is more efficient and professional)
- ✓ TV stations might be interested in a documentary if you have an innovative/sustainable business model like AFS/U-pick/CSA
- ✓ **Offline** options include word-of-mouth, signage, market stands, roadside stands (only if stealing is prevented) and newspaper ads.
- ✓ **Advertise** pressing services well before the harvest season so that customers know to store their walnuts, not give them away.
- ✓ When talking to customers, always be friendly and identify their needs to recommend them the perfect product (consider demographic, interests like nutrition, gifts or own garden)
- ✓ Communicate clearly and honestly, while communicating respectful boundaries if needed (stealing, contacts, visiting without permission)
- ✓ Include storytelling (history of walnuts, farm) and education (regionality, nutrition, AFS) in your communication.
- ✓ Show rather than tell: demonstrations of your product and AFS benefits can help educate
- ✓ Communicate positive externalities of AFS that are relevant for the LRR (reducing runoff, aesthetics, shade...)
- ✓ Marketing should be focused on customer needs (Kotler and Armstrong, 2012). Listen to customers questions and use these to tailor your marketing strategy.

4.5. SIVA marketing guidelines: Value

Prices for walnuts from local producers and German producers can be found in Table 2: Weighted average price/kg by store type and kernel type in Kleve. Producers adjust prices for different marketing channels and over time to reflect increases in energy use or processing. Prices are typically calculated based on working time, purchase price of walnuts or other ingredients, and materials or logistics. Prices also vary depending on place of origin, growing system and cultivar. Typical prices from local producers range from 4€ to ca. 12€/kg for in-shell walnuts (upper price limit is organic or higher quality), while high-quality local kernels fall between ca. 30€-40€ per kg (normally in smaller packages, ranging from 50g-500g). Market prices can vary: Prod. C notes that the market “Lindchen” in Uedem didn’t pay a high enough price for their walnuts, so they decided to sell via a market seller in a different market instead.

Profit: Results show that selling unprocessed walnuts is the most profitable, since each processing step costs time. Therefore, streamlining harvesting and processing is crucial for profitability. Producers' percentage of income from walnuts varies heavily, from 1-5% to a full-time business. However, all rely on combined sources of income, like events, consulting, or a tree nursery, to make ends meet. Less efficient processes can make working time disproportionate to profit: as C says about their harvesting: "*Zumal, die Stunden, die man braucht zum Auflesen, das kann man nicht gegenrechnen! Also, den Stundenlohn rechnet man besser nicht!"* To solve this, they have recently purchased a vacuum harvesting machine to make the process more efficient and ergonomic.

Lifestyle/Scene: Interviewees describe themselves and their customers as being in a "scene", or a community of people interested in sustainability, gardening, or health. For B., Marktschwärmer was a big part of the "scene", which they describe as "modern, hip". Walnuts also support certain lifestyle choices for customers: Customers in this scene are willing to take the time and pay a premium to harvest their own nuts (U-Pick) and enjoy cracking nuts as a "meditative activity" in winter evenings.

Organizations like NABU, Ökonauten, or Marktschwärmer are all associated with ecological practices and/or short food supply chains supporting small farms, and they draw in consumers who are interested in those values. Thus, fostering a community to show how walnuts can support a healthier, more sustainable, or more mindful lifestyle is a powerful marketing tool.

AFS also has a "scene" of its own, and so marketing for AFS walnuts could reach out to permaculture, food forest and other alternative communities, who would be interested in products grown in such systems (see Agroforst Reallabor, IG Nuss, Waldgartenkongress, DeFAF e.V.). AFS also offers additional perks: for example, health-conscious customers may be interested in products from AFS with lower pesticide use, while customers who have their own gardens could be interested in seminars or events about this new growing system. Cracking could also be marketed as a "meditative" or "offscreen" activity, alongside the appropriate cracking tools, encouraging customers to take the time to engage with the product and their local food system.

Creativity and **testing** out products are important factors in producers' marketing strategies and business development. Producers typically began their businesses through testing out different marketing strategies on a small scale for example via Marktschwärmer, roadstands or farmers' markets. Creativity is seen in diverse product offers and packaging (such as gift baskets, events, pressing services), testing out new processing methods (oil pressing, Prod. B) and development of more efficient processes (such as scaling up drying facilities, Prod. C). They also encourage customers to be creative with products themselves by including recipes for things like walnut butter or walnut meal. Based on this, producers of AFS walnuts would be advised to test their products on groups of customers and to adopt a creative mindset when designing products.

Uniqueness/rarity: Currently, German walnut producers will already have the unique benefit of early market entry, since a walnut-focused farm or business is still rare in the region. However, producers should make sure they stay unique as local competition grows, for example, by investing in sustainable business practices. A. recently invested in a new cracking facility and developed an energetic concept using walnut shells for heating. This would likely also appeal to the sustainability-minded customer base.

Interviewees report that both customers and supermarkets like REWE and EDEKA value **regionality**. However, opinions were divided over whether customers were willing to pay over market price for regional walnuts. In general, customers with a sustainable focus are willing to invest time and money to access a quality regional product. However, in a supermarket, average customers will normally focus on price first.

Meanwhile, local partnerships with other businesses who share similar values signal connectedness with the region and helps producers expand their customer bases while showing deeper commitment to those values. For example, A highlights the values of their business partners by including sustainable "buzzwords" like “women's cooperative”, “bean-to-bar”, or “small manufacturer” in their product descriptions.

Results show that ensuring excellent **quality** and flavor is crucial to maintaining customer loyalty, as customers will return for high quality but also bring back poor-quality walnuts to the seller. Producers should therefore ensure excellent quality by drying at cool temperatures and performing professional quality control at all processing stages (harvest, sorting, drying, storage), as well as checking water content and testing for mold and other harmful substances. In doing so, they can set themselves apart from imported walnuts: B mentions that quality walnuts are hard to find, and this is reflected also in negative reviews on the flavor of some imported walnuts (Aldi Süd, 2024, Alnatura, 2024). The guidelines around Value are summarized in Table 5: Key takeaways for producers: Value.

Table 5: Key takeaways for producers: Value

Key takeaways for producers: Value
✓ Typical **prices** from local producers range from 4€ to 12€/kg for in-shell walnuts (upper price limit is organic or higher quality), while high-quality local kernels fall between 30€-40€ per kg (normally in smaller packages from 50g-500g).
✓ The more processing steps there are, the less **profit** you have from a product, so make sure your harvesting and processing steps are efficient.
✓ Supplement your income with services or a tree nursery to make ends meet.
✓ Use the existing walnut and AFS "**scene**" to reach more customers.
✓ Create a **community** and show how walnuts can support a healthier, more sustainable, or more mindful **lifestyle**.
✓ Get **creative** and test out products on friends and family, markets or via Marktschwärmer.
✓ Currently, being a German walnut grower will already be a unique trait, but make sure you stay **unique** as local competition grows (i.e. invest in sustainable business practices)
✓ Customers and local supermarkets value **regionality** and are sometimes willing to pay more for it.
✓ Highlight the positive **values** that you and your business partners follow (i.e. organic, fairtrade, circular economy, women's cooperative, small business)
✓ Ensure excellent **quality** by drying at cool temperatures and performing professional quality control at all processing stages (harvest, sorting, drying, storage). Check for mold, water content and harmful substances.
✓ Customers like to make purchases that express their values ((Stephenson et al., 2019, Ottman, 2011)) Make your values clear through your marketing, and your business & farming practices.

4.6. SIVA marketing guidelines: Access

Based on the interviews, **distribution** options for walnuts include farm shops, seasonal markets, online shops, Marktschwärmer, local supermarkets, a secure roadside stand, or personal networks. Typical market themes are harvest festival (Erntedank) and Christmas markets. Deliveries or pickups of large orders are best combined with other trips for more efficiency. Producers should also keep in mind that market sellers will want to buy walnuts as early as possible (i.e. by October).

Farm shops can include a customer toilet and additional area for seating and could be in renovated outbuildings or barns. Natural light and plenty of space for customers makes for a pleasant working and shopping environment. Selling to other farm shops that do not have their own walnut production is another option.

Sometimes, customers themselves become an extension of the distribution system, for example one Turkish customer of Prod. C, who buys almost 100kg of walnuts and sends them to friends and family in Turkey, where walnuts are very popular and yet extremely expensive.

Distances include three typical customer radiuses: farm shop draws local, regular customers and day-tourists from up to 60km away. Supplying markets is possible in a 30-80km radius, the farther away the market is, the less often producers sell there, or they sell via a secondary market seller/middleman. Finally, an online shop or unique services like oil pressing can draw customers from all over Germany and beyond.

Marktschwärmer is a farm-to-market facilitator that allows customers to order in their online shop and then has producers deliver exact to order to pick-up points. For Prod. B, this offered a low-threshold entry into the market, where B. could flexibly decide when and how much product to offer. B. describes this freedom as very helpful when testing products in early stages of their business. In addition, Marktschwärmer offers extremely fresh produce and has a modern and "hip" image, drawing in younger customers from big cities. However, B says that there are many middlemen in the system, making it quite complicated and expensive. In addition, driving to distribution points at peak traffic times can be problematic, especially when farms are far from the nearest "Schwärmerei".

Finally, both B+C mentioned partnering with supermarkets like REWE and EDEKA, which are both very interested in regional products; however, they both find that this is only possible for larger producers who can supply enough product. As B says: *"Aber [Edeka] ist dann schon wieder eine Hausnummer, wo ich raus bin, weil mir das zu viel wird. Dafür habe ich zu spät angefangen."*

While honor-based road stands require a location that is very public or close to the farm to maintain customer accountability, a vending machine might be a good low-labor option for a more remote location close to a heavily-traveled bike path or road, and it could include processed products or snacks, directly targeting both the health-conscious/sporty demographic and opportunistic buyers with very little time and effort on the producers side.

Demographic: based on the results, (see Figure 8) producers should target younger customers (under 40) with nutrition and sustainability-focused marketing. This group tends to buy walnuts from a more nutrition conscious or sport-related motivation and is the typical age for Marktschwärmer. Attract older customers (40+) by connecting them to the history of walnuts and services. B finds that contract pressing customers are normally older, (60+) as they tend to have a different mindset around utilizing what they have and more time to invest in preparing walnuts for pressing. All customers respond well to high quality, flavor, and a community.

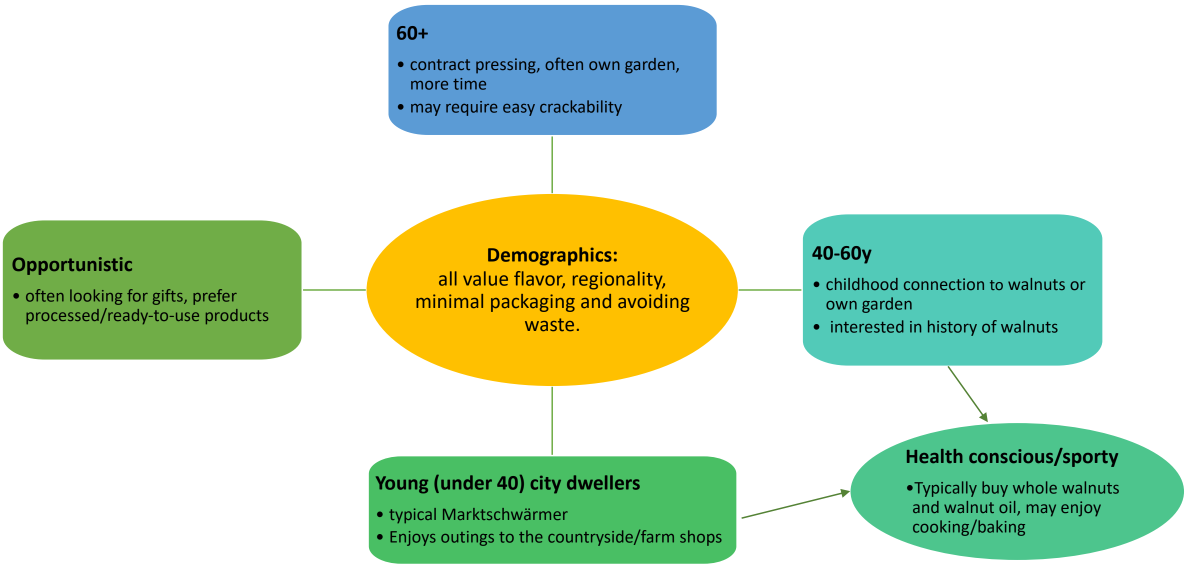

Figure 8: Demographics of typical regional walnut customers

Since the population in the LRR is aging and shrinking (ALP Institut, 2021), producers should particularly consider marketing to aging customers, who may not be as digitally native, but who may be interested in the history of the walnut due to childhood memories and may have more time to engage with activities or services like walnut oil pressing. In addition, an online shop or traveling to city markets could help producers expand their customer base with younger, more urban customers outside of the LRR.

Competition mainly consists of the mature French and Californian walnut markets (French walnuts can reach prices of 7-8€/kg). To be competitive against imported walnuts in stores, walnut producers should first follow industry standards and strive for efficient working processes, given high labor prices in Germany. However, there is less competition from other German producers: as A puts it, “*mit deutschen Nüssen zu handeln heißt halt auch, mit Anfängern zu arbeiten,”* meaning that German producers still have a lot to learn. Since walnut trees take 5-10 years to reach full bearing, planting walnut trees early is a distinct advantage against later competitors in the German market. Good quality grafted walnuts with a high kernel-to-shell fetch higher prices than ungrafted walnuts. In the long run, producers will mainly set themselves apart with value-based purchases and unique products. Meanwhile, forming a network with other local walnut producers may be an alternative to competing with them, especially since current producers like A+B are highly interested in supporting new producers.

These **networks** are a theme across all the interviews: German walnut producers are currently more supportive than competitive. Therefore, new producers would be advised to become engaged in their growing networks. For financing land or other investments, Ökonauten and Lokalhelden could be beneficial. AFS-related networks like Agroforst Reallabor and DeFAF e.V. provide consultation, while the IG Nuss offers support for growing walnuts. LIKK e.V. offers access to processing machinery in the Kleve area. Marketing could start via local farm shops or Marktschwärmer, as well as social media, using AFS or permaculture networks to expand access to their walnuts. In addition, contacting walnut producers across Germany would be advised, since they seem willing to support new producers.

Finally, producers should ensure **convenience**, especially for opportunistic customers on markets. Interviewees find that processed products and ready-made gift options are popular among first time customers. An online shop is easily accessible for younger, digital demographics, while this may not be the case for older demographics. The crackability of in-shell walnuts is also a concern for older customers, so consider this when choosing new cultivars. The guidelines around Access are summarized in Table 6: Key takeaways for producers: Access.

Table 6: Key takeaways for producers: Access

Key takeaways for producers: Access
✓ **Distribution** of products via: farm shop, seasonal markets, online shop, Marktschwärmer, local supermarkets or farm shops, a secure roadside stand or personal networks.
✓ A farm shop draws local, regular customers and day-tourists from up to 60km away. Supplying markets is possible in a 30-80km radius, the farther away, the less often or via a market seller. An online shop or unique services like oil pressing draw customers from all over Germany and beyond.
✓ **Demographic:** target younger customers (under 40) with nutrition and sustainability-focused marketing, older customers (40+) by connecting them to walnut history/services. Target all with high quality flavor and a community!
✓ Customers with a sustainable focus are generally willing to invest time and money to access a good product (i.e. U-pick, traveling to pick up nuts) However, in a supermarket, average customers will normally focus price first.
✓ Ensure **convenience**, especially for first-time customers/opportunistic customers on markets. Consider crackability and processed/ready-made gift options. An online shop is easily accessible for younger, digital demographics.
✓ **Timing:** advertise for pressing services early to prevent customers discarding excess nuts. Provide market sellers with walnuts as early as possible (i.e. by October)
✓ **Competition:** mainly French walnuts at 7-8€/kg or California walnuts. Follow industry standards and maintain efficient processes, to stay competitive, but mainly set yourself apart with value-based purchases and unique products.
✓ **Networks**: German walnut producers are currently more supportive than competitive. Tap into consulting and machine-sharing networks like IG Nuss and LIKK e.V., or AFS networks like DeFAF e.V. and AF Reallabor for support.

4.7. Summary of results

The following graphic visualizes the keys ways that agroforestry, walnuts and the Lower Rhine Region could offset each others' negative aspects (in red) in a marketing strategy (Figure 9).

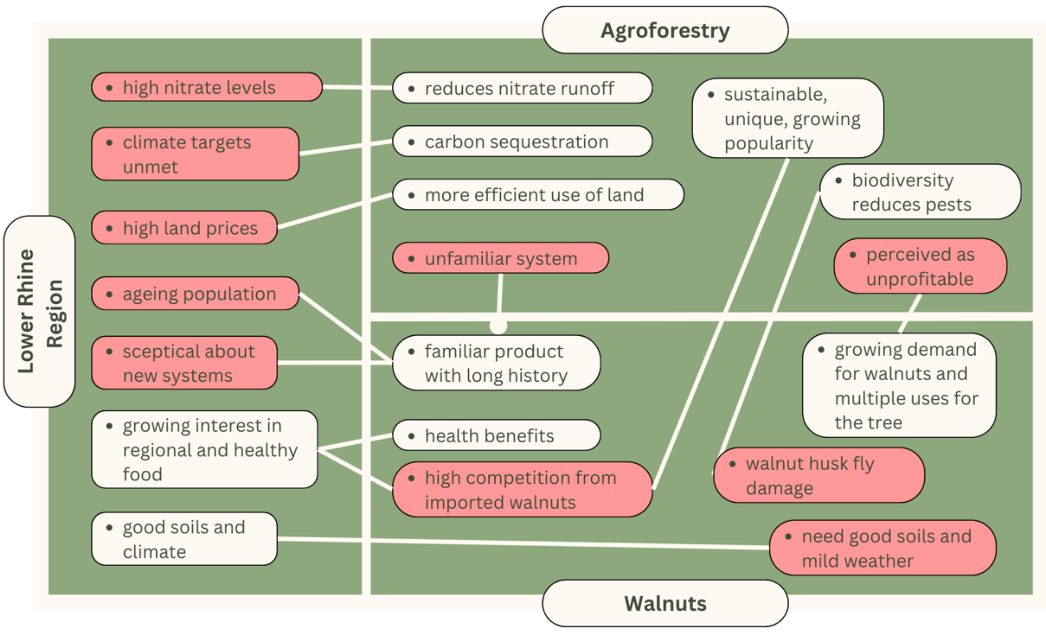

Figure 9: Complementary factors of AFS-grown walnuts in the LRR (red=negative aspects)

5. Discussion

5.1. Impact of agroforestry on marketing walnuts in the LRR

In previous literature, there was very little available research on AFS or walnuts in the Lower Rhine Region (Kayser, 2023a). Since the interviewees for the most part did not grow their walnuts in AFS, the context of the literature review was used to adapt the marketing guidelines to AFS-grown walnuts.

In general, the literature review and results show that AFS could benefit the Lower Rhine Region, for example, by helping to combat nitrate pollution in a livestock-heavy area (van der Wiel et al., 2021), while offering shade and alternative fodder for said livestock, or by making more efficient use of land where farmland is increasingly hard to access (according to Prod. C), and reducing pressure on local commercial forests which are increasingly at risk from drought, wildfires and pests like *Ips typographus* (MLV NRW, 2023). Finally, increased biodiversity and carbon sequestration could help the Lower Rhine Region reach Germany's climate targets successfully, while the greater economic diversity resulting from AFS could help stabilize farms during transition periods. Notably, farmers in NRW are an aging demographic, and many farms are looking for a successor (IT NRW, 2021b). While B finds that some people in the Lower Rhine Region are slow to accept new ideas like AFS, interviews also show that younger farmers are becoming more interested in planting walnut trees and AFS. Thus, new producers may be able to collaborate with farmers to transition into agroforestry, using the proven economic benefits of AFS to help convince older farmers of the validity of their business plan.

While the benefits of AFS for the Lower Rhine Region are clear, there are still many barriers that prevent farmers from wanting to adopt AFS. The barrier examined primarily in this thesis was the lack of markets for agroforestry products that accurately reflect their value (Litschel et al., 2023, Sollen-Norrlin et al., 2020). This thesis shows that walnuts are commonly grown in AFS systems (Andrianarisoa et al., 2016, Graves et al., 2007, Wang et al., 2015), they are highly nutritious and culturally significant in Germany (CBI, 2019, Fan et al., 2023), and the tree itself has many other uses (Böllersen, 2019, Pontow, 2018). Furthermore, this thesis finds that the LRR is climatologically suited for producing walnuts: with rich, deep soils, a mild climate and medium rainfall (Deutscher Wetterdienst, 2024, BGR, 2024). This makes walnuts an ideal AFS product for the Lower Rhine Region, which could encourage farms to invest in AFS systems.

The remaining concern is competition, since the literature review shows that the German walnut market is heavily saturated with imported walnuts (FAO, 2024). However, this thesis makes it evident that, firstly, there is a growing market potential for regionally produced walnuts, and secondly, the positive externalities of AFS (such as climate benefits) could be leveraged to increase this market potential. In addition, German walnut producers seem more supportive than competitive, a sentiment also found in Litschel et al. (2023), who describe a "pioneering spirit" in the young walnut community. In addition, many supermarkets are now demanding regional products, but the need for economy of scale and a steady supply stream when selling via large chains like EDEKA and REWE is also echoed by (CBI, 2019, Pontow, 2018).

Results show that the main concerns for walnut producers in the LRR are late frost and the walnut husk fly. Choosing hardy cultivars, and ensuring good field hygiene can minimize damage, while nuts darkened by the walnut fruit fly could be sold shelled or simply accompanied by customer education. Potentially, increasing the biodiversity of the AFS with other plants and animals could lessen pest pressure. Anecdotal evidence suggests that chickens might help reduce walnut husk fly populations (Alston et al., 2015), while chemical control mechanisms can be found for example in Verheggen et al. (2017).

5.2. Interviewees' marketing strategies vs. literature review

When looking at section 2.7 Farm-gate marketing of walnuts, most of the existing findings hold true for marketing AFS-grown walnuts in the LRR. For example, results show that successful producers encourage **values-based purchases**Farm-gate marketing of walnuts, especially for health-conscious consumers. They express their **personality** through storytelling, and they use marketing strategies like Marktschwärmer that foster a **community.** Most importantly, they ensure that the **function** of their walnuts is superior to most imported walnuts by checking for good quality and flavor. All of this aligns with existing recommendations for producers as found in the literature review.

However, several unexpected debates that arose in the interviews are worthy of note: firstly, regarding **certifications:** results showed that, while customers like to make values-based purchases, they do not seem to require third-party organic certification to legitimize these purchases. This is surprising because research shows that organic certification is important to 60% of average German customers, while 38% of consumers buy organic producer at least "often" (BMEL, 2022b). Instead, results show that the more distant the customer relationship, the more important such certifications are. This phenomenon is explained by A, who says that direct marketing allows customers to see how much work goes into the walnuts and legitimizes a higher price, rendering a certification unnecessary. This may partly explain why B and C were more skeptical of organic certification: they have very close customer relationships, making the added cost and workload of certification not worthwhile. This could be important when developing an agroforestry label or certification, which has been considered by i.e. (Sänn and Pauly, 2017).

Another debate surrounds **Marktschwärmer**, which, while it offers benefits like flexibility and a well-known reputation for new producers, comes under critique from B for having too many middlemen and taking too much profit. Since Marktschwärmer is known for being a farm-gate marketing portal focusing on direct and local sales, this critique was surprising. While this critique may be biased, producers may want to look critically at this and similar services and consider the cost-benefit ratio carefully.

Finally, a key finding is that marketing strategies for local walnuts go **beyond the product** itself. Initially, given the saturated walnut market and the long-term nature of walnut production, the author expected that marketing for AFS walnuts would have to be a product-focused "push-strategy", using lots of advertising to "push" the product into the market (Kotler and Armstrong, 2012), (see also 3.7 Hypothesis).

However, it seems the opposite is true: instead of focusing on the qualities of their walnuts alone, producers A and B expand the product into a greater issue, connecting walnuts to health, heritage, and a better local food system, all in a nutshell. This transforms local walnuts into a **values-based purchase,** which research shows is very important to modern consumers (Ottman, 2011). Similarly, B's story of discovering what they could do with their walnut tree invites customers to discover their own gardens. Thus, buying B's products and services becomes not just a purchase but an invitation into a **community,** a factor found in successful direct-marketing models like Marktschwärmer or agriculture (CSA), (Stephenson et al., 2019). These factors create a "pull" effect, as seen in 4.4 Communication, and producers say that they could even sell more walnuts than they have available.

Values-based purchases and **community** are a powerful combination: perhaps because customers like to "feel empowered to make a difference" (pg. 110, Ottman (2011)) and being in a like-minded community magnifies this effect. Therefore, producers of AFS walnuts would be advised to leverage these two factors. Given increasing climate activism in recent years, the climate benefits of AFS will make AFS-grown walnuts a popular **values-based purchase**, while customers can be integrated into the growing **communities** around AFS and alternative growing systems (Agroforst Reallabor, Waldgartenkongress, Permakultur Niederrhein e.V.). In this way, AFS would be a significant advantage when marketing locally grown walnuts.

5.3. Limitations and further research

As the author was previously inexperienced in methods of qualitative research, the interview questions were adjusted and improved with each interview. While this allowed a better fit of the interview to each interviewee, (and is permitted by i.e. (Mayring, 2015) Gläser and Laudel (2010)) this led to some discrepancies between interviews. As suggested by Gläser and Laudel (2010), ideally the author would have completed a pilot study to better understand what questions were relevant to the research questions before beginning the actual study. Further research could build on this thesis as a pilot study and improve the results by expanding the number of interviewees. Researchers should consider using a coding software such as MAXQDA, as used by i.e. Hofman (2019), which would have been a valuable tool for the analysis process.

Regarding methodology, the SIVA framework was both loose enough to allow flexibility and still provide structure as expected. However, it reaches its limitations when looking at complex values-based marketing strategies. Aspects such as regionality and sustainability blur the lines between the four categories, making it challenging to address all the connections between various marketing aspects without repetition.

Regarding the collection of walnut prices for the local walnut market section: since this data collection was not meant to be the focus of the thesis, it is by no means an exhaustive list of all the walnut products available in the Lower Rhine Region or in Kleve. Instead, it is meant to give a small insight into the current price ranges, and therefore any statistical power is highly limited. Producers would be advised to do their own research on prices, or to seek out current sources that use a broader range of data.

Finally, one interesting insight of this thesis was the critique that organic associations and Marktschwärmer had too many middlemen and thus reduced profits. While this issue is heavily discussed around organic certification, an interesting analysis might look critically at Marktschwärmer and consider if and how it contributes to a more direct food system.

5.4. Conclusion

In summary, to answer the three research objectives: firstly, the current market situation for walnuts in the LRR is generally positive: experts state that the market would be receptive for more walnuts than they can currently produce or source, while the environment for new producers and farmers interested in AFS is increasingly supportive. However, producers will have to maintain efficient working processes and high quality standards to remain competitive against imported walnuts.

To address the second and third questions, what can future AFS walnut producers draw from local walnut producers' marketing strategies? Based on the results, new producers should provide walnuts and processed products that not only have a better flavor than imported walnuts, but that help customers make a sustainable impact, i.e. by engaging them in a community working towards a better local food system. Integrating AFS into all parts of the SIVA framework supports this goal: reduced pesticide needs and a more diverse farm means that the **solution** goes beyond a better walnut and extends into additional positive externalities for the region. Producers should demonstrate AFS benefits in an engaging way as part of their **information,** which adds **value** to an already quality product, allowing producers to potentially ask a higher price for their walnuts. Finally, to make it easy to **access** AFS-walnuts, producers could sell online, via supermarkets or Marktschwärmer, depending on target demographic, but should consider that personal customer contact makes it easier to create a community and communicate the higher value of AFS-grown walnuts.

In essence, while strategic marketing, efficient labor management and quality products are required to compete with more established competitors, this thesis finds that new walnut producers in the Lower Rhine Region could compete with imported walnuts and that agroforestry would be an asset to their marketing strategy.

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7. Appendices

Table 7: Raw data from Table 2 including weight factors collected by the author in Kleve

Store type	**Product type**	**Price/kg**	**Weight (# of products in same store & product type)**	**Price*Weight**
discounter	in shell	3.70 €	2	7.40 €
discounter	in shell	8.90 €	2	17.80 €
drugstore	in shell	13.93 €	1	13.93 €
German producer	in shell	12.00 €	4	48.00 €
German producer	in shell	3.00 €	4	12.00 €
German producer	in shell	8.50 €	4	34.00 €
German producer	in shell	6.50 €	4	26.00 €
local producer	in shell	4.00 €	1	4.00 €
online	in shell	11.38 €	2	22.76 €
online	in shell	8.75 €	2	17.50 €
supermarket	in shell	3.98 €	4	15.92 €
supermarket	in shell	9.90 €	4	39.60 €
supermarket	in shell	8.73 €	4	34.92 €
supermarket	in shell	9.97 €	4	39.88 €
discounter	kernels	11.93 €	3	35.79 €
discounter	kernels	12.95 €	3	38.85 €
discounter	kernels	12.45 €	3	37.35 €
drugstore	kernels	11.67 €	2	23.34 €
drugstore	kernels	19.90 €	2	39.80 €
German producer	kernels	30.00 €	2	60.00 €
German producer	kernels	30.00 €	2	60.00 €
local producer	kernels	40.00 €	1	40.00 €
online	kernels	15.27 €	3	45.81 €
online	kernels	29.27 €	3	87.81 €
online	kernels	22.00 €	3	66.00 €
organic store	kernels	23.27 €	1	23.27 €
German producer	kernels broken	26.00 €	1	26.00 €
online	kernels broken	14.92 €	3	44.76 €
online	kernels broken	13.50 €	3	40.50 €
online	kernels broken	10.50 €	3	31.50 €
organic store	kernels broken	16.45 €	2	32.90 €
organic store	kernels broken	22.45 €	2	44.90 €
		SUM:	**84**	**1,112.29 €**
		SUM weight* SUM(price*weight)=	**Total weighted average price:**	**13.24 €**

Table 8: Producer A: SIVA marketing strategy summary

Solution/ Product	**Intrinsic properties:** Diverse cultivars, sells walnuts in-shell and by cultivar and origin. Over 30 different cultivars including rarities like the dark red “Hospozin” or the giant “Börderiesen”. • Supplements young walnut plantation with purchased walnuts from local gardens, German and Hungarian producers. **Packaging**: plastic-free, paper or glass containers. **Certification**: Organic certified, additional certification as partner of NABU and local food networks **Processing**: Unique processed products like walnut mustard or chocolate covered walnuts from own or local processing. • Quality control on every purchase and regular testing for harmful substances. **Services** and other products include: walnut tree nursery, consulting for new walnut producers, walnut-themed events and lectures.

	Branding is young, down-to-earth, and humorous and shows them as a bold challenger disrupting the walnut industry.
Information/ Promotion	**Labelling**: Writes "everything they can think of" under the products. Very detailed, clear information on all products available on website. • Transparent information on everything: walnut origin, their own origin story, business partners, processing, and product quality. **Online marketing:** • Uses Instagram and Facebook to share pictures of harvest, products, processing, or information about walnuts. Also includes seasonal marketing of products or a raffle. Characterizes people and relationships: staff portraits, thanking colleagues. • Doesn't have a YouTube channel, but several interviews and a Galileo report were made about them and are available there. **Offline marketing:** • Unconcerned about popularity/marketing reach in future due to early market entry. • Enjoys communicating with customers on markets. Important factors for successful communication: being friendly, quickly understanding what the customer needs and what their interests are. • Swears by direct customer contact: showing how much work goes into production helps develop customer understanding for higher local prices than imported walnuts.
Value/Price	**Prices**: differentiate between origin and type: garden walnuts, organic and non-organic. • Prices closer to organic price: 12€/kg for organic/sorted in-shell walnuts, 3€ and up for garden in-shell walnuts (from surrounding private gardens) • Price determined by: purchase price, working time, materials, logistics, and additional shipping costs. • While they try not to go over organic prices for walnuts, the prices for processed products are less flexible to market pressure due to lower profit margin. **Value**: Customers purchase local walnuts mainly for health reasons or out of interest in walnuts/having their own tree. • A big part of their marketing strategy is experimenting, trying out new products and improving existing ones. • Unique/rare products: assorted box of different rare walnut cultivars, walnut mustard or preserved green walnuts. • Invested in their own cracking facility and an energetic concept using walnut shells for heating: these things generate interest and increase their notability in the region.
Access/Place	**Distribution system:** 95% direct marketing: farm shop, seasonal markets (Christmas and Erntedank in the Berlin-Brandenburg area) and online shop **Distance**: Customers come from around 60km radius. Some Berlin tourists. Regulars are from the region and normally purchase in-shell walnuts. **Demographic**: age 40+, health-motivated consumers (regulars, choose nuts or nut oil) or people seeking gifts on Christmas markets (mainly processed products) **Location**: Farm shop is currently being renovated and will have a larger sales area and a customer toilet, allowing for a better customer experience in future.

Table 9: Producer B: SIVA marketing strategy summary

Solution/ Product	**Intrinsic properties:** Walnuts are from one old tree (cultivar unknown, ca. 100kg.) and additional 600kg of organic walnuts purchased from Zieler in Hamburg. **Packaging**: minimal, in glasses for most products. Labels are easily removable in water.

	Processed walnut products like oil and cakes make up majority of sales:. Most popular product in the individual walnut cakes. (pers. comm. with Prod. B, 20.3.24) **Certification**: Does not want to be organic certified for cost and effort reasons, but feels that buying organic walnuts ensures better quality control of products. **Services**: began contract oil pressing with own oil press for friends and family. Then started making products to demonstrate use of walnut pomace (byproduct of pressing). Pressed 500kg of walnuts from private customers last year. • Main goal is to encourage customers to bring their own walnuts for pressing. Customers pay for the pressing service and then take all the oil and byproducts back with them. The pressing service makes up about half of their business, a bit more than half is direct sales. • Also presses other soft seeds like hazelnuts and rapeseed. Walnuts are registered allergens, so any other nuts processed/pressed with walnuts must be marked as cross-contaminated. • Also offers cracking machine for people to crack their own walnuts. **Branding**: changed common farm name to a more unique name including “walnuts”.
Information/ Promotion	**Labeling**: Minimal, only what is required. Pressing date on walnut oil. Labels are made with water-soluble paste to be easily removable. **Online marketing:** does not want to have an online shop, considers it too difficult. **Instagram & Facebook:** pictures of products and processing, information about business and location of next market sales **Youtube** channel with videos from WDR reports. **Offline marketing:** Enjoys having lots of personal communication with customers. Chose Marktschwärmer to better present themself with products. newspaper advertisement 2-3 times per year, WDR television report around every 2 years. • minimal advertising for products themselves, focuses on pressing service • Provides recipes for walnut butter • does not identify as a “brand” but feels that they have a lot of unique information on walnuts and can share it in an interesting way. • demonstration of many walnut-related themes: from processing byproducts to planting small walnut varieties suitable for private gardens.
Value/Price	**Prices**: walnut kernels: 2€/50g, oil: 125ml 7€, oil pressing: 10€ first kg wlanuts, 5€ for each following kg (Source: personal communication with Prod. B, 20.3.24) **Prices** determined by: purchase price, price of additional ingredients, working time. Marktschwärmer and market stand prices are somewhat higher than prices when customers purchase directly in the farm shop. • occasional comparison with competitors, but prices are less flexible to cover costs and produce a profit. **Value**: The clientele is already very interested in keeping packaging minimal and avoiding a throwaway mindset. • Marktschwärmer is modern, hip and “in the scene” • Likes to experiment with new products due to close customer relationship • Their regional walnuts have a better flavor, it is difficult to find quality walnuts on the general market. • customers value regional products regardless of age and are willing to invest time and money to get regional walnuts
Access/Place	**Distance**: contract pressing is rare in Germany, therefore customers are willing to come from farther away • most customers of come from the immediate region, some write via email and then Producer B sends them a package.

	Distribution system: a bit more than half of product sales come via Marktschwärmer: customers order over internet and then pick up at the Schwärmerei. • deliveries to 2-3 local farm shops make up remainder of sales **Demographic**: for oil pressing 60+, for Marktschwärmer much younger. **Location**: good location/setting, renovated old horse barn, afternoon light, pleasant working space.

Table 10: Producer C: SIVA marketing strategy summary

Solution/ Product	**Intrinsic properties:** sells in-shell walnuts from seven old walnut trees that were planted on the family farm in 1993 • various unknown cultivars, trees are ungrafted but have very good flavour. One tree has smaller, dark nuts with excellent flavour but are less popular due to size and colour. • New plantation (63 trees, 1.8ha.) was planted by daughter in 2023, cultivars include Chandler, Franquette, Moselaner 120 and Weinheimer 139 • Old walnut trees are not sprayed or chemically treated but are adjacent to a conventional cornfield. **Certifications**: Not organic certified but might consider certification for AFS in future depending on cost. Currently in process of registering the new system as an AFS. **Packaging**: in mesh potato bags **Processing**: only drying of in-shell walnuts, cracking, and vacuum-packing only for personal use. **Branding**: New plantation will be marketed under the name "Niederrhein Nuss".
Information/ Promotion	**Labels**: No labels on mesh bags, since reseller does not care about labelling • Reseller most likely does not add any additional labelling to walnuts. **Marketing/advertising:** Limited, only word-of-mouth. Honor-based roadside stand did not work because nuts and/or money kept getting stolen. No website or social media presence. **Communication**: Mostly communication via Whatsapp to get nut order from fixed customer base. Otherwise, word-of-mouth and selling to existing friends and family. • Regularly must tell passersby who collect nuts without permission to stop stealing nuts. • Communicates to customers that walnuts are not sprayed or chemically treated.
Value/Price	**Price + Profit:** 4€/kg in-shell nuts. Does not include working hours since harvest is so time consuming. Revenue is around 1000€ per year in recent years. • Considers selling unprocessed walnuts to be most profitable strategy. Each processing step costs time that is not reflected in profits. **Value**: Walnuts have excellent health benefits and could have potential among sporty customer bases as well. • Crackability of nuts is an important factor for older customers. New walnut cultivars were selected for crackability as well. **Flavor**: one customer returned specifically because he could not find any walnuts that tasted as good. In general, customers appreciate good flavor.
Access/Place	**Distance**: widely spread over Germany. **Distribution system:** • Market reseller buys about 2/3 of walnut harvest each year and sells them in Ratingen on the market. • Remainder is private sales mostly to friends and family, via Whatsapp. Nuts are ordered in advance and then picked up or delivered via personal networks.

- In future, (when new plantation is bearing) would consider selling via supermarkets and farmers' markets in the region, as well as other farm shops.

Demographic: customers are diverse, but all tend to be nutrition-conscious. Age 50-60 and younger.

8. Declaration of authenticity

I, Isabelle Decher, hereby declare that the work presented herein is my own work completed without the use of any aids other than those listed. Any material from other sources or works done by others has been given due acknowledgement and listed in the reference section. Sentences or parts of sentences quoted literally are marked as quotations; identification of other references with regard to the statement and scope of the work is quoted. The work presented herein has not been published or submitted elsewhere for assessment in the same or a similar form. I will retain a copy of this assignment until after the Board of Examiners has published the results, which I will make available on request.

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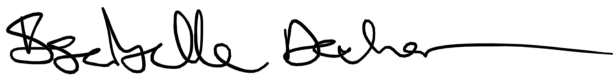

Kleve, the 17. of May 2024