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1 ANALYSIS OF THE ECONOMIC PROFITABILITY OF MORINGA FARMING IN 1 THE
URBAN COMMUNE OF AGADEZ. 2 3 ABSTRACT 4 Moringa plays an important socio-
economic role in Niger. It produces edible leaves used in 5 human consumption, which
also constitute a source of income for producers. Therefore, this 6 study aims to analyze
the economic profitability of Moringa farms in the Agadez commune 7 by highlighting the
factors influencing profitability levels. It was conducted using a database 8 compiled from a
survey carried out in the study area with 115 Moringa producers . The 9 methodological
approach adopted was, firstly, a descriptive and differential analysis of the 10 socio-
economic characteristics of the farms and producers, the operating accounts, and 11
economic profitability. The analyses show that 95.7% of the farmers surveyed consider 12
market gardening to be their main activity, although nearly 84% of the respondents did not
13 receive any support or guidance. The results of this study have demonstrated the
significant 14 source of food and income for producers of this plant, with an average net
income of 391,569 15 FCFA/ha. The profitability rate achieved for producers is 92.7 % ,
meaning that income 16 exceeds expenses. For example, if a Moringa producer invests 5
FCFA, they should receive a 17 profit of 4,635 FCFA. Therefore, Moringa farming is
economically viable in the study area. 18 Keywords:Moringa , profitability, farms, Agadez.

19 20 1. INTRODUCTION 21 Moringa farms contribute significantly to improving
household living conditions, particularly 22 through harvesting, leaf sales (generating
income), and self-consumption. It has a direct 23 impact on diet, malnutrition prevention,
improved livelihoods, and water quality (ACH24 NIGER, 2010). In Niger, Moringa oleifera
is primarily cultivated for leaf production and 25 human consumption. Thus, Moringa leaves
contribute to the resilience of many households 26 against food and economic
vulnerability. This plant is cultivated under irrigation in market 27 gardens, either as a
monoculture or in association with other plants, and its main production 28 areas are the
city of Niamey and its surroundings, the Maradi region, and Tillabéry (Manzo 29 et al .,
2016). According to a 2015 study by the National Institute of Statistics (INS), the 30 share
of revenue from Moringa sales in a farmer's total income is estimated at 29.92%. This 31

share is estimated at 42.8%, 34.0%, 33.3%, 23.1%, and 16.4% respectively in Niamey, 32 Maradi, Tillabéry, Tahoua, and Dosso, representing less than one-third of total income on 33 average. The remaining two-thirds come largely from the sale of vegetables and food crops 34 grown between rows of Moringa trees in agroforestry systems and in monocultures of cereals 35 and food crops, as well as from livestock sales. A 2021 study by the High Commission for 36 the 3N Initiative reveals that the Moringa value chain represents 1.1% of the national GDP 37 and 2.5% of the agricultural GDP. In the municipality of Agadez, given the importance of 38 Moringa , particularly its contribution to improving household income and food security, as 39 well as its other uses, this study was conducted to thoroughly analyze the profitability of this 40 crop.as well as its contribution to household income. 41 42 2. MATERIALS AND METHODS 43 2.1 Study Area 44

2 The urban commune of Agadez is located in the department of Tchirozerine and lies between 45 the mouth of the Irhazer plain and the Air massif. With an area of 600 km², the urban 46 commune of 5 Agadez is the regional capital according to Law No. 2003-35 of August 27, 47 2003. It is bordered to the east, west, and north by the urban commune of Tchirozerine and to 48 the south by the rural commune of Aderbissanat, and is situated between 16°56'44" North 49 latitude and 7°57'42" East longitude (PDC, 2018). 50 51

Figure 1: Study municipality 52 2.2 Equipment 53 The study used various materials to collect information. Specifically, data collection tools 54 appropriate to the field were employed. The study used a questionnaire distributed to farmers 55 for primary data collection; a car for visiting agricultural sites in the Agadez commune that 56 produce irrigated moringa ; a motorcycle for obtaining supplementary data; and a camera for 57 taking photographs. 58 59 60 61 62 63 2.3 Methods 64 2.3.1 Sampling 65

3 The sampling method applied at each site for this study was carried out in two stages. The 66 first stage involved contacting technical services and farmer leaders. The collaboration of 67 these two experienced agricultural stakeholders, who are familiar with

the area, allowed us to 68 determine the number of Moringa producers in 2023 at 459 sites in the Agadez municipality. 69 The sampling method was simple random sampling; respondents were selected from a list, 70 each assigned a number, giving each producer an equal probability of being chosen. The 71 objective was to survey at least 25%, or one-quarter, of the target producers. Thus, data 72 collection involved 115 Moringa farmers in the study area. 73

Table 1: Sampling of the population visited 74

Sites	Number of operators	Sampling Men	Women	Total	Men	Women	Total
Azamalan	72	12	84	18	3	21	
Alikinkin	41	3	44	10	1	11	
Aladab	50	34	84	13	8	21	
Toudou	56	4	60	14	1	15	
ToudouN'Bila	127	20	147	32	5	37	
Tchiguefene	40	0	40	10	0	10	
Effective	386	73	459	97	18	115	75

2.3.2 Data Collection 76 Secondary data were collected from regional, departmental, and municipal technical services 77 and libraries to obtain technical and general information about the study area. This data 78 allowed for an overview of the concepts and theories relevant to the research topic. Primary 79 data were obtained through individual interviews and focus groups . This phase involved 80 collecting data using a questionnaire containing questions about socio-economic 81 characteristics, financial resources, and expenses incurred in farming operations. In addition 82 to these individual interviews, focus groups and observations were conducted to gather further 83 information and identify missing or irrelevant data from the farmers. 84

2.3.3 Data Processing 85 All data were processed according to their nature. Means and standard deviations were 86 calculated for quantitative variables, while proportions were calculated for qualitative 87 variables. Descriptive statistics (frequencies, means, and standard deviations) for each 88 variable and comparison tests of means for economic profitability elements were performed 89 using R and SPSS software, Microsoft Excel for creating figures and tables, and Microsoft 90 Word for word processing. 91

2.3.4 Determinants of Economic profitability Moringa production 92 Some authors have attempted to define profitability and methods for its evaluation (Babacar 93 et al., 2020). Economic profitability is a measure of a company's economic performance in 94 utilizing all of its employed capital. Total employed capital equals the sum of equity, provided 95 by capital providers, plus capital

acquired through debt. Economic profitability is therefore 96 independent of the type of capital financing and expresses the capacity of invested capital to 97 generate a certain level of profit before the payment of any interest on the debt (Soumana, 98 2011).

According to Pirou (2005), profitability is the capacity of capital to generate income. 99 Profitability can also be defined as a company's ability to make profits over a given period. 100 The gross margin, which is the balance of the production account, equals the value of 101

4 production minus the value of intermediate consumption. Indeed, the elements below were 102 used to determine the economic profitability of Moringa production : 103 □ Gross margin (GM) is calculated as follows : 104 $MB = \text{Noise Product} - \text{Operational Loads}$ (1) 105 Operating costs include the amounts allocated for the purchase of seeds, organic fertilizer, 106 cultivation costs, transportation costs, food and snack costs, the purchase of plastic bags, and 107 the transportation costs of those bags. Gross output or revenue is obtained by multiplying the 108 total quantity of the output by its unit price. 109 □ Net margin (MN) is the difference between gross margin (MB) and fixed costs, 110 formulated as follows: 111 $MN = MB - \text{Fixed costs}$ (2) 112 Fixed costs relate to the depreciation of the following equipment: Motor pump, Gas bottle, 113 Pipes, solar panel installation, shovel, pickaxe, hoe, hoe, knife, rakes, machete. 114 □ Linear depreciation is calculated as follows : 115 $\text{Amortization} = (n_i * P_i / D_i)$ (3) 116 Or : 117 $\text{Amortization} = \text{depreciation of equipment}$; 118 n_i = the number of copies of the equipment considered at the same operator. 119 P_i = the unit purchase price; 120 D_i = the lifespan of the equipment. 121 122 □ The added value created per product (AV) is estimated according to the following 123 formula from Fabe et al. (2009) : 124 $VA = PB - CI$ (4) 125 PB represents gross product in FCFA; CI, intermediate consumption in FCFA . 126 □ Economic profitability measures a producer's ability to create value through their 127 activity. Its ratio is calculated as follows: 128 Economic profitability ratio: $(\text{Net operating profit}) / (\text{Invested capital})$. (5) 129 □ The rate of return (r) is obtained using the formula: 130 $r = R/I \times 100$ (6)

131 Where: $R = \text{net operating profit}$ and $I = \text{amount of investment}$. 132 With $R=VA-$
 (Remuneration for work + Financial expenses + Taxes + Depreciation). 133 Note:
 Operators do not pay taxes or duties, and therefore do not incur financial charges. For 134
 the purposes of this study, the invested capital consists primarily of amounts invested
 during 135 the year. 136 137 3. RESULTS 138

5 3.1 Socioeconomic characteristics 139 Socioeconomic characteristics were obtained
 from questions on variables such as the support 140 received by farmers, membership in
 farmers' organizations, the farmers' socio-professional 141 activity, reasons for being
 producers, the nature of the relationship between buyers and 142 farmers, and the type of
 buyers. Table 2 illustrates the description of these variables below. 143 Table 2:
 Descriptive statistics of variables 144 145 Furthermore, the distribution of farmers
 according to the support received is illustrated in 146 Table 2. Analysis of this table shows
 that 83.5% of producers received no support 147 whatsoever; that is, they do not belong to
 any organization. The remaining 16.5% received 148 training in the production and
 processing of Moringa , with most of the women involved in 149 processing. This table
 reveals that market gardening is the primary occupation, practiced by 150 95.7% of
 farmers. Moreover, the analysis of secondary activities in the table above indicates 151
 that this population's secondary occupations are limited to livestock farming (60.9%) and
 152 small-scale trade (25.2%). 153 The study shows that the primary reason for becoming
 a producer is family (85.2%), as 154 children are introduced to farm work from a young
 age. An additional 11.3% of respondents 155

Variables	Terms and conditions	Effective Frequency	Management
Yes	19	16.5%	No
No	96	83.5%	Affiliation with Peasant Organizations
Yes	19	16.5%	No
No	96	83.5%	Primary activity
Market gardening	110	95.7%	Official
Trade	2	1.7%	Livestock farming
Livestock farming	1	0.9%	Craftsmanship
Craftsmanship	1	0.9%	Secondary activity
Official	4	3.5%	Trade
Trade	29	25.2%	Livestock farming
Livestock farming	70	60.9%	Market gardening
Market gardening	3	2.6%	Craftsmanship
Craftsmanship	7	6.1%	Masonry
Masonry	2	1.7%	Producers' reason for being
Family	98	85.2%	Friend
Friend	13	11.3%	NGO
NGO	4	3.5%	Link between buyers and operators
Link between buyers and operators	Link in sight	57	49.6%

Persistent link 9 7.8% Contractual link 23 20.0% Visible and persistent 25 21.7% Visual and contractual 1 0.9% Buyers Men 14 12.2% Women 5 4.3% Two at a time 96 83.5%

6 became producers through relationships with other producers. According to the research, 156 farmers' organizations are not very developed in the area. The analysis shows that 157 membership is very low, with only 16.5% of the producers surveyed belonging to a producer 158 organization. 83.5% of farmers are not affiliated with any organization. Those who do belong 159 to organizations receive training and technical support. The table above reveals that the most 160 common type of relationship between farmers and buyers is a visual connection (49.9%). 161 However, 21.7% and 20% of producers report having visual and ongoing relationships, 162 respectively, and contractual relationships. According to these respondents, everyone in the 163 same gender buys Moringa leaves .It appears in this table that 83.5% of men and women buy 164 the production compared to 12.2% of men and 4.3% of women. 165 166 3.2 Analysis of the economicsMoringa leaf production 167 3.2.1 Producer's operating account 168 Table 3 shows the diverse and varied expenses incurred by the farmers, as well as the 169 revenues obtained by the surveyed farmers. Average expenses are obtained by dividing total 170 expenses ² by the number of farmers. Average revenues are obtained by dividing total revenues 171 ² by the number of farmers. Table 3 presents the accounts of the surveyed farmers: 172 Table 3: Operating Account of theproducer in FCFA 173 174 This table shows that variable costs consist of all current expenses incurred during the 175 respondents' farming campaigns. In the context of this research, these include inputs such as 176 manure, day laborers, and family labor for cultivation. ² The average variable cost is 256,692 177 FCFA. Fixed costs consist of permanent staff and depreciation of equipment used by the 178 farmers. The average of these two values is 221,228 FCFA for fixed costs. The sum of these 179 Charges Products Section Amount Section Amount Seeds 22308 Moringa 781723 Fertilizer 37037 Associated cultures 175957 Pesticide 23859 Energy consumption 57285 Manure 4955 Day laborers 31154 Family Labor

(MOF) 80094 Total variable costs (VC) 256692 Permanent workers 116609 Equipment depreciation 104672 Total fixed costs (FC) 221281 Total costs (CV+CF) 477793 Operating profit 479707 Total 957680 Total 957680

7 variable and fixed costs gives the total production costs (477,973 FCFA). The profit from the 180 associated Moringa production (957,680 FCFA) exceeds the costs (477,793 FCFA) , resulting 181 in an operating profit of 479,707 FCFA for Moringa production . The account balances 182 because the total expenses plus operating profit on the left side of the table equal the total 183 revenue on the right. Therefore, Moringa production provides a positive economic profile for 184 farmers in the study area. 185 3.2.2 Profitability of the economic Moringa leaf production 186 3.2.2.1 Added value created by the activity 187 Moringa production obtained by producers in the commune of Agadez is determined in Table 188 4. 189 Table 4: Added value created by the activity in FCFA 190 Based on the analysis of this table, the added value was determined by the difference between 191 the gross product and intermediate consumption plus depreciation of the equipment used. For 192 the purposes of this study, intermediate consumption includes inputs (seeds, fertilizers, 193 pesticides, and energy consumption) and the use of organic manure. Following this 194 calculation, the added value created by this activity averages 663,002 FCFA , with a range of 195 approximately 476,505 FCFA. 196 3.2.2.2 Rate of Return 197 As a reminder, 3 the rate of return is the ratio of net operating income to the amount of 198 investment. The net production margin was determined by subtracting total costs per hectare 199 from the gross output per hectare, or by subtracting fixed costs per hectare from the gross 200 margin. These values are presented in Table 5. 201 Table 5: Rate of Return 202 Elements Average Standard deviation Noise margin (MB) 572194 394274 Net Margin (NM) 391569 230710 Net operating profit 361763 186658 Profitability ratio 0.927 0.528 Rate of return (%) 92.7 52.8 203 204 205 206 207 208 Elements Average Standard deviation Noise reducer (Moringa) 781723 584012 Variable charges (VC) 209529 189738 Fixed costs (FC) 180625 163564 Added value 663002 476505

8 209 210 211 4. DISCUSSION 212 Socioeconomic characteristics of Moringa farms in the study area: 213 Analysis of the results shows that the primary reason for becoming a producer is family 214 (85.2%), as children are introduced to agricultural work from a young age. An additional 215 11.3% of respondents became producers through relationships with other farmers. These 216 friends adopted this practice because of the income it generated. These results are consistent 217 with those found by IDI (2021) in Maradi, where 87.7% became producers through family 218 and 12.3% through friends. According to the study, farmers' organizations are not very 219 developed in the area. The analysis shows very low membership rates, with only 16.5% of the 220 producers surveyed belonging to an organization. 83.5% of farmers are not affiliated with any 221 organization. Those who do belong to organizations receive training and technical support. 222 Table 2 shows that market gardening is the main socio-professional activity, accounting for 223 95.7%. This rate of 95.7% is explained by the fact that producers are turning to market 224 gardening, which appears to be the activity requiring fewer constraints and providing them 225 with a significant income. These results are consistent with those found in the PDC-Agadez 226 (2018) . Links exist between buyers and producers in the event of sales. Table 2 shows that 227 the most common type of link between producers and buyers is a visual relationship (49.9%). 228 However, 21.7% and 20% of producers state that they maintain visual and persistent 229 relationships, and contractual relationships, respectively. These figures are close to those 230 found by IDI in 2021. In Maradi, the distribution is as follows: 45% direct sales, 12% direct 231 and ongoing sales , and 37% contractual. Direct sales account for half of the transactions, but 232 in most cases, farmers have no choice but to sell to whoever is closest, even if they have 233 relationships with other buyers. This is because Moringa leaves do not keep for long (at most 234 24 hours) after harvesting. According to the respondents, all genders purchase Moringa 235 leaves. Table 2 shows the proportion of buyers by gender. This table shows that 83.5% of 236 buyers are men and women, with 12.2% of men and 4.3% of women purchasing the produce. 237 This

result contrasts with that obtained by Chipkaou (2020) in Tillabéry, where 100% of 238 buyers were women. This is explained by the fact that women and men play an important role 239 during the harvest, especially in the sale of Moringa leaves. The first point of purchase is at 240 the local market, where women and men buy Moringa leaves by the bundle. The purchase 241 price is based on the number of bundles harvested. In most cases, those who buy Moringa 242 leaves in bulk resell them at the market. Only 4.3% of women buyers process the leaves 243 themselves. According to those involved, these purchases of all kinds foster competition 244 among buyers, which benefits farmers because it allows them to sell at a higher price and 245 increases the profitability of their harvests. 246 Analysis of the economics moringa leaf production in the municipality of Agadez: 247 The study notes that the gross margin was obtained by subtracting variable costs from gross 248 revenue. This calculation yielded an average gross margin of 572,194 FCFA, with a range of 249 approximately 394,274 FCFA. The net margin was calculated by deducting the gross margin 250 from the total cost per hectare. This result yielded a value of 391,569 FCFA with a standard 251 deviation of 230,710 FCFA . This figure is similar to that found by CHERIF (2010) in the 252 Niamey urban area, which was 381,800 FCFA/ha. This is explained by the fact that Agadez is 253 a suitable area for Moringa production , although producers in this area face enormous 254

9 difficulties, namely insufficient or complete lack of water, especially during the hot, dry 255 season, and a lack of support and necessary equipment. This leads to the determination of the 256 net operating profit, which was calculated using a specific formula. 257 The result obtained is 361763 FCFA with a standard deviation of 186658FCFA. However, 258 economic profitability was obtained by subtracting invested capital from net operating 259 income, where invested capital is simply the expenses incurred during the year. This 260 calculation yielded an economic profitability ratio of 0.927, with a range around 0.528. 261 Finally, The rate of return was calculated, which is simply the ratio of net operating profit to 262 the investment amount, or the economic

profitability ratio multiplied by one hundred. In this 263 study, the investment amount is the sum of all production costs, including family labor. This 264 calculation yielded an economic 1 rate of return of 92.7 %, with a dispersion of around 52.8%. 265 This result is higher than that found by Soumana and Ali (2021) in the Djirataoua 266 commune of Niger, which was 61.5% for the rate of return on moringa leaf cultivation . 267 Therefore, the resulting rate of return is positive at 92.7 %, meaning that the revenue 268 generated exceeds the expenses incurred. For example, if a producer invests 5 FCFA in 269 Moringa cultivation, they should make a profit of 4,635 FCFA. We can conclude that 270 Moringa farms in the Agadez commune are economically viable. 271 CONCLUSION 272 In light of the above, this article aimed to analyze the economic profitability of Moringa 273 farms in the Agadez municipality by examining various profitability indicators. This analysis 274 was conducted using a database compiled from a survey of 115 producers. The 275 methodological approach involved a descriptive and differential analysis of the socio276 economic characteristics of the farms, their operating accounts, and the economic profitability 277 of Moringa leaves in the study area. The analysis revealed that 95.7% of the surveyed farmers 278 considered market gardening their primary activity, despite nearly 84% reporting that they 279 had not received any formal training or support. This situation warrants particular attention 280 from NGOs and the government to promote new techniques and technologies in order to 281 prevent serious problems in the near future. The results of this study have demonstrated the 282 significant source of food and income for producers of this tree species, with an average net 283 income of 391,569 FCFA/ha. This income is used for food and other needs. The profitability 284 rate achieved by moringa producers in the Agadez commune is 92.7 % . Therefore , the 285 activity is economically viable from a capital investment perspective. This is because the rate 286 is positive, meaning that the income generated exceeds the expenses incurred. For example, if 287 a moringa producer invests 5 FCFA, they should receive a profit of 4,635 FCFA. 288

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