Inventory of traded exotic plants in the city of Batna, Algeria

Feriel Kheira Kebaili, Adel Bezzalla, Mostefa Ababsa, Hani Amir Aouissi

Correspondence

Feriel Kheira Kebaili[1], Adel Bezzalla[2,3], Mostefa Ababsa[4], Hani Amir Aouissi[1*]

[1]Environmental Research Center (CRE), Annaba 23000, Algeria
[2]Department of Ecology and Environment, Faculty of Natural and Life Sciences, University of Batna 2, Fesdis, Batna 05000, Algeria
[3]Laboratory of Biology, Water & Environment (LBEE), Faculty of SNV-STU, University of 8 May1945 Guelma. PO. 401, Guelma 24000, Algeria
[4]Scientific and Technical Research Center on Arid Regions (CRSTRA), Biskra 07000, Algeria

*Corresponding Author: h.aouissi@cre.dz

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Research

Abstract

Background: The global trade of exotic species of plants has seen significant expansion hence raising concerns about the ecological and economic consequences. This study aims to identify the most commonly traded exotic species in the city of Batna, Algeria, and to explore the pricing dynamics in this local market.

Methods: This study is based on the results of an investigation conducted among six plant shops in the region. The controlled variables include the existing exotic species, the total number of species and individuals, as well as the buying and selling prices.

Results: The results indicate a total of 35 species with 1137 individuals. Cactus was the most prevalent species, with 248 individuals. *Cycas revoluta* Thunb. is the most expensive species, priced at 60.000 Algerian Dinars (DA) and the Bamboo was the most encountered species. In addition, a strong linear relationship was found between the retailer's purchase and sale prices ($r = 0.998$, $P < 0.0001$), with regression analysis indicating that 99.7 % of the variance in sale price is explained by purchase price ($R^2 = 0.997$, $P < 0.0001$).

Conclusions: This research provides a solid foundation for future investigations into the impact of this trade on biodiversity and the conservation of exotic species, specifically in the Batna region. Further studies could also be conducted to understand consumer motivations and evaluate the ecological consequences of this practice.

Keywords: Exotic plants, plant trade, sale and purchase, Batna, Algeria.

Background

Throughout history, humans have always tried to transform their abiotic and biotic environment at an ever-increasing pace (Gómez-Márquez 2025). As a result, thousands of plant species have been cultivated and continue to be transported by humans in areas far from their natural habitat, or are displaced accidentally (unwanted seeds, roots and even shoots). Parts of plants are introduced into vehicle and machinery parts, in crops transported by animals, human and other activities, or voluntarily (such as ornamental plants, forage, or erosion control), or in the past or present (Smit 2004), and these are called exotic plants, a collective term used to describe plants that are not indigenous in a given country, introduced and cultivated to meet human needs. According to (Semenya *et al.* 2012) the humans are highly dependent on exotic plant species for their food, shelter, ecosystem services, aesthetic pleasure, and cultural identity. There are different categories of exotic plant species, including those that are considered naturalized, weedy or invasive. Naturalized alien species are considered weeds or invasive species that breed and maintain populations over more than one cycle.

Invasive alien species are another potential threat to the diversity of native plants. Recent studies have shown that more than 13,000 species, or 3.9% of the world vascular plant flora, have naturalized somewhere outside their area of origin as a result of human activity (van Kleunen *et al.* 2015; Montagnani *et al.* 2022). Tropical regions generally have fewer naturalized species than temperate regions, but these numbers are increasing as direct trade between tropical countries overcome the geographical barriers that have isolated the major tropical regions during the period when most modern species evolved (Corlett & Primack 2011). Although invasive plant species can have massive local ecological, economic and social impacts (Simberloff *et al.* 2013). They are the components of global change (Evans *et al.* 2001), reducing native plant diversity via reduction of species richness (Vilà *et al.* 2015) and modifying fire regimes and nutrient cycling and contributing to the erosion of biogeographic barriers by dispersal of species by humans in new areas, according to (Simberloff *et al.* 2013).

In the world, the cultivation of exotic plants has known, since antiquity and intensified at the beginning of 1600s. Estimates indicate that there are more than 374 000 plant species worldwide (Christenhusz & Byng 2016).

In Algeria, given the richness and the original diversity of its flora, Algeria constitutes a real reservoir with about 3951 native taxa (species and subspecies), and about 290 Algerian endemic species (Meddour *et al.* 2023). In addition, according to Meddour *et al.* (2020) there are about 211 vascular species of alien plants, from 151 genera and 51 families. However, there were only a few studies in Algeria, the most prominent were the one of Meddour *et al.* (2020) that provides the first comprehensive inventory of alien vascular plant species in Algeria, highlighting the significant presence of naturalized and potentially invasive exotic flora in disturbed and ruderal environments. Another study by Sakhraoui *et al.* (2019) realized a survey and identified potentially invasive alien plant species cultivated in nurseries and gardens, characterized their biological traits and degrees of naturalization, and established a preliminary list to support monitoring and management of their cultivation and spread. However, this study focused only on the region of Skikda. Finally, a more recent study by (Sakhraoui *et al.* 2024) who reported 74 additional alien vascular plant taxa recorded in Algeria, including first national records for several species, and updates the counts of naturalized and potentially invasive taxa, increasing the known alien plants and emphasizing the dynamic and growing scope of plant introductions. More specifically, the city of Batna is characterized by the cultivation of non-native plants outside their region of origin. However, information remains fragmented or even non-existent, the study of interest in the region were those of (Hannachi & Fenni 2013) who characterized the weed flora of the Batna region as comprising 120 species dominated by annual broadleaf weeds, and demonstrated that weed distribution patterns are structured by crop type, climatic conditions and soil factors. Another important study has been conducted by (Chohra & Ferchichi 2019) in Belezma National Park (Batna region) based on ethnobotanical surveys, the authors documented 50 medicinal plant species across 27 families and demonstrated that local therapeutic practices are dominated by decoctions of leaves and stems primarily used to treat digestive, urogenital, respiratory and musculoskeletal disorders, highlighting the park as a valuable reservoir of traditional knowledge and a potential resource for phytochemical and pharmacological research.

In this context, this study aimed to investigate and identify existing exotic plants traded in the city of Batna, the study also seeks to examine the price of each species, and to explore the factors that shape these price differences, whether they relate to rarity, demand, or specific uses. Our study may provide a better understanding of how plant trade influences broader patterns of introduction and naturalization across Algeria

Materials and Methods

Study area

We carried out an exploratory floristic and ethnobotanical study of exotic plants through a series of field trips to the City of Batna (see Figure 1).

Geographically, the municipality (Wilaya) of Batna is located in the eastern part of Algeria, at the junction of the Tellian Atlasand the Saharan Atlas. The neighboring wilayas are: Oum El Bouaghi, Mila and Sétif in the North, Kenchela in the East, M'sila in the West and Biskra in the South (Ministry of Tourism & Handicrafts 2021). The city of Batna is historically considered the capital of the Aurès. The downtown is located in the central part of the territory of the wilaya, it extends over a total area of 11641 hectares and is limited as follows: to the North: by the municipality of Fesdis, Seriana, Oued El Ma, to the South: by the commune of Tazoult, to the East: by the commune of Ouyoun El Assafir, to the West: by the commune of Oued Chaaba.

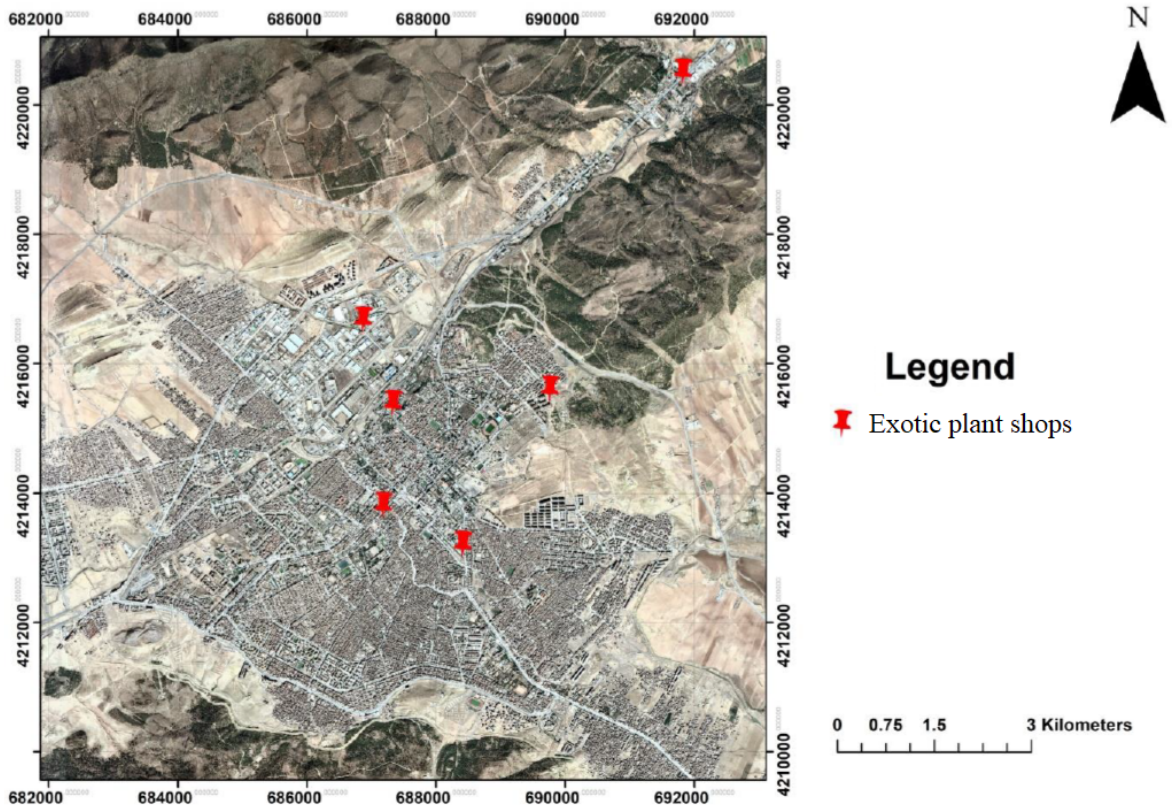

Figure 1. Geographical Map of the Study Area

Methodology

For the purpose of this work, several steps were followed to ensure the collection of qualitative data on exotic plants traded in the city of Batna, here are the steps:

Site Selection

Using geographical mapping, plant shops were identified. In our case, all identified stores were visited for this exploratory research to provide a representative sample of the local exotic plants trade market in the city of Batna. Here, we considered a "plant shop" as any fixed commercial outlet where exotic plants were available to purchase by the population, including permanent stands, storefronts and nurseries.

Data Collection

A fieldwork was conducted from December 2022 to April 2023. At each site, information was collected through direct interview with sellers, in addition to personal observations of the plants that we found in the shop.

Identification

All exotic plants that we find in the stores were noted, as well as their order, family, genus and species. Their identification and taxonomy have been carried out mainly using "Plants of the World Online" (POWO 2025) database, in addition to consultation with a local expert from the University of Batna 2 for confirmation.

Collected results

Data regarding the total number of each species, the origin, and the place of purchase were collected. In addition, economic data was also collected and included both sale and purchase prices, to analyze pricing variations and factors influencing the value of plants.

All these steps were followed in order to provide a clear representation of the quantity, diversity, and potential economic importance of exotic plants in the city of Batna.

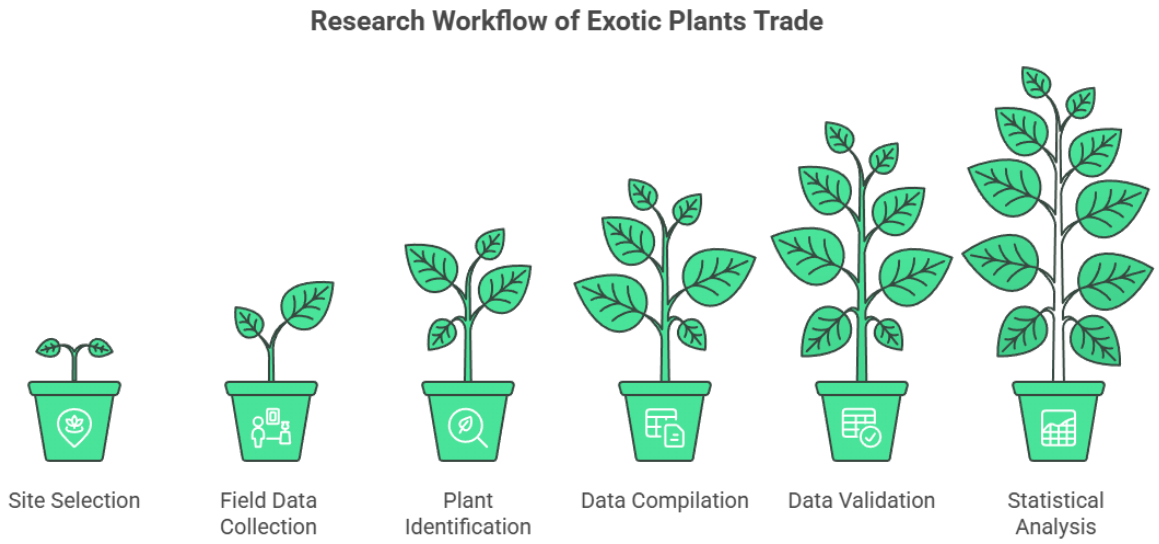

Figure 2. Research Workflow of Exotic Plants Trade (The authors using Napkin.ai)

Statistical Analysis

The data collected was organized and processed using Microsoft Excel (v.2019) for descriptive statistics. Then, JMP Pro (v.18) software was used for the correlation and regression analysis.

Results

Characterization of exotic plants

Types of shops sampled

The results presented in Table 1 show that the sites are of two types: flower shops, native and exotic plants and nurseries of native and exotic plants, with variable areas.

Table 1. Type of the six sampled shops

Number	Shop Name	Type	Origin of purchase
1	*Le Prince des fleurs*	Private	Zéralda
2	*Les Fleurs de Batna*	Private	Zéralda
3	*Aurès Garden*	Private	Zéralda
4	*Le coin vert Fesdis*	Private	Zéralda
5	*Pépinière les frères Bloum-Tazoult*	Private	Zéralda
6	*Pépinière ERGR Aurès*	State-owned	Cultivated

We have noticed that the larger the sales area, the more plants are sold, which is logical. However, we also noticed that the exotic plants sold by the 5 private plant sellers were purchased in Zéralda, near Algiers (the capital city of Algeria), while the exotic plants from the state-owned shop are cultivated on-site.

List of Inventoried Species

Table 2 lists the exotic species found on the six sites.

Table 2. List and number of exotic species sold in the city of Batna

Genus	Order	Family	Scientific Name	N (Individuals)
Sansevieria	Asparagales	Asparagaceae	*Sansevieria stuckyi* God.-Leb.	103
Dracaena	Asparagales	Asparagaceae	*Dracaena draco* (L.) L.	11
Cordyline	Asparagales	Asparagaceae	*Cordyline fruticosa* (L.) A. Chev.	2
Yucca	Asparagales	Asparagaceae	*Yucca aloifolia* L.	55
Bambusa	Poales	Poaceae	*Bambusa vulgaris* Schrad. ex J.C. Wendl.	56
Pteridium	Polypodiales	Pteridaceae	*Pteridium aquilinum* (L.) Kuhn	1
Alocasia	Alismatales	Araceae	*Alocasia macrorrhizos* (L.) G.Don	1
Epipremnum	Alismatales	Araceae	*Epipremnum aureum* (Lind. & André) Bunting	1
Ficus	Rosales	Moraceae	*Ficus elastica* Roxb.	37
Philodendron	Alismatales	Araceae	*Philodendron giganteum* Schott	1
Opuntia	Caryophyllales	Cactaceae	*Opuntia microdasys* (Lehm.) Pfeiff.	248
Stephanotis	Gentianales	Apocynaceae	*Stephanotis floribunda* (R. Br.) Brongn.	1
Ophrys	Asparagales	Orchidaceae	-	1
Codiaeum	Euphorbiales	Euphorbiaceae	*Codiaeum variegatum* (L.) A. Juss.	1
Rosa	Rosales	Rosaceae	*Rosa canina* L.	65
Chamaedorea	Arecales	Arecaceae	*Chamaedorea elegans* Mart.	30
Cycas	Cycadales	Cycadaceae	*Cycas revoluta* Thunb.	20
Thuja	Pinales	Cupressaceae	*Thuja occidentalis* L.	127
Araucaria	Pinales	Araucariaceae	Araucaria araucana (Molina) K.Koch	17
Cocos	Arecales	Arecaceae	*Cocos nucifera* L.	5
Gazania	Asterales	Asteraceae	*Gazania rigens* (L.) Gaertn.	14
Petunia	Solanales	Solanaceae	*Petunia integrifolia* (Hook.) Schinz & Thell.	20
Leucanthemum	Asterales	Asteraceae	*Leucanthemum vulgare* Lam.	18
Rosa	Rosales	Rosaceae	*Rosa damascena* Mill.	9
Geranium	Geraniales	Geraniaceae	*Geranium dissectum* L.	13
Schefflera	Apiales	Araliaceae	*Schefflera arboricola* (Hayata) Merr.	31
Aloe	Asparagales	Asphodelaceae	*Aloe vera* (L.) Burm.f.	52
Hyphaene	Arecales	Arecaceae	*Hyphaene thebaica* (L.) Mart.	2
Crassula	Saxifragales	Crassulaceae	*Crassula ovata* E.Mey. ex Harv. & Sond.	50
Haworthia	Asparagales	Xanthorrhoeaceae	*Haworthia fasciata* (Willd.) Haw., 1821	4
Washingtonia	Arecales	Arecaceae	*Washingtonia robusta* H.Wendl.	26
Nolina	Asparagales	Asparagaceae	*Nolina recurvata* (Lem.) Hemsl.	6
Bougainvillea	Caryophyllales	Nyctaginaceae	*Bougainvillea glabra* Choisy	5
Agave	Asparagales	Asparagaceae	*Agave angustifolia* Haw.	100
Monstera	Alismatales	Araceae	*Monstera deliciosa* Liebm.	4

According to Table 2, there are a total of 35 species with a total number of individuals in the order of 1,137. The most abundant species are: *Opuntia microdasys* (Lehm.) Pfeiff., with 248 individuals, *Thuja occidentalis* L. with 127 individuals, *Sansevieria stuckyi* God.-Leb with 103 individuals, and *Agave angustifolia* Haw. with 100 individuals.

Number of Species

The results recorded in Table 3 shows that the number of exotic plants in the six stores varies.

According to Table 3, there was a minimum of 1 individual and a maximum of 195 individuals. Thus, the stores “Le coin vert Fesdis” and “Pépinière ERGR Aurès” are those with the highest average number of individuals (40 and 44.88, respectively). On the other hand, the smaller stores “Fleurs de Batna” and “Aurès Garden” have an average of only one individual.

Table 3. Distribution of species with their numbers by site

Shop	N (Species)	Min (Ind)	Max (Ind)	Sum	Mean	Std. Deviation (SD)	Variance
Le Prince des fleurs	5	1	16	21	4,20	6,611	43,700
Les Fleurs de Batna	5	1	4	8	1,60	1,342	1,800
Aurès Garden	6	1	3	8	1,33	0,816	0,667
Le coin vert Fesdis	5	20	65	200	40,00	17,678	312,500
Pépinière les frères Bloum-Tazoult	11	5	20	137	12,45	4,762	22,673
Pépinière ERGR Aurès	17	1	195	763	44,88	53,485	2860,610

Table 4 shows the average purchase and sale price of each species in Algerian dinars (DA).

Table 4. Average purchase and sale price for each species.

Species	Average Purchase (DA)	Average sale (DA)
Sansevieria stuckyi God.-Leb	250	350
Dracaena draco (L.) L.	525	775
Cordyline fruticosa (L.) A. Chev.	1300	1500
Yucca aloifolia L.	1850	2650
Bambusa vulgaris Schrad. ex J.C. Wendl.	590	760
Pteridium aquilinum (L.) Kuhn	1500	2000
Alocasia macrorrhizos (L.) G.Don	1800	1375
Epipremnum aureum (Lind. & André) Bunting	1500	1800
Ficus elastica Roxb.	700	1075
Philodendron giganteum Schott	3500	4800
Opuntia microdasys (Lehm.) Pfeiff.	550	500
Stephanotis floribunda (R. Br.) Brongn.	3200	4500
Codiaeum variegatum (L.) A. Juss.	2500	3600
Rosa canina L.	120	200
Chamaedorea elegans Mart.	200	300
Cycas revoluta Thunb.	40000	60000
Thuja occidentalis L.	180	2500
Araucaria araucana (Molina) K.Koch	2500	2450
Cocos nucifera L.	3000	5000
Gazania rigens (L.) Gaertn.	150	250
Petunia integrifolia (Hook.) Schinz & Thell.	180	300
Leucanthemum vulgare Lam.	200	300
Rosa damascena Mill.	280	450
Geranium dissectum L.	200	300
Schefflera arboricola (Hayata) Merr.	230	375
Aloe vera (L.) Burm.f.	/	250
Hyphaene thebaica (L.) Mart.	/	300
Crassula ovata E.Mey. ex Harv. & Sond.	/	230
Haworthia fasciata (Willd.) Haw., 1821	/	250
Washingtonia robusta H.Wendl.	/	850
Nolina recurvata (Lem.) Hemsl.	/	500
Bougainvillea glabra Choisy	/	250
Agave angustifolia Haw.	/	250
Monstera deliciosa Liebm.	/	650

Based on Table 4, the most expensive species is *Cycas revoluta* Thunb. Also known as the false palm tree, it is a slow-growing plant that forms a trunk over the years, belonging to the order Cycadales and the Cycadaceae family.

The species with the highest average purchase price is *Cycas revoluta* Thunb. At 40,000 DA, this species also has the highest average selling price (60,000 DA). However, the species with the lowest average purchase price (120 DA) is *Rosa canina* L. Logically, it is also the species with the lowest average selling price (200 DA).

Analysis of the commercial performance of exotic plants

Descriptive statistics of species on the market

Figure 3 highlights the number of species present in the sampled stores. Thus, the "Pépinière les frères Bloum-Tazoult" (N=11) and the "Pépinière ERGR Aurès" (N=17) are those with the most species.

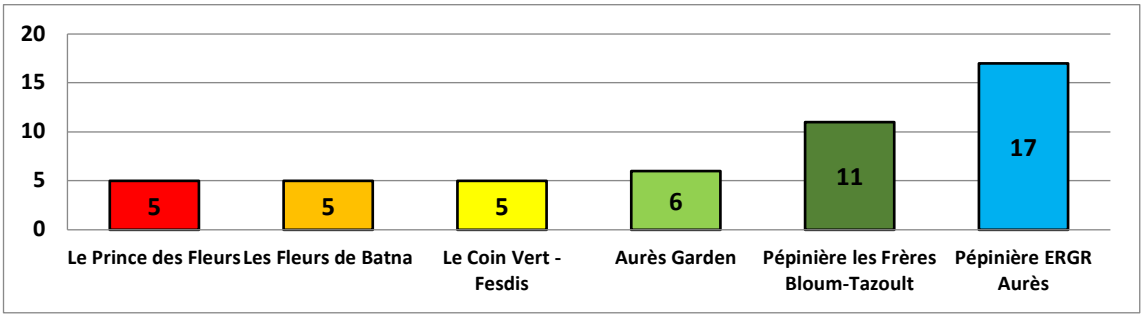

Figure 3. Number of exotic species per store

Descriptive statistics for the purchase and sale prices

The descriptive statistics for the purchase and sale prices (in Algerian Dinar) of the 26 plant species included in the study are presented in Table 5 (species with no available purchase average were excluded from the analysis). The mean purchase price was 2,738.65 DA (SD = 7,697.55), while the mean sale price was 3,973.46 DA (SD = 11,544.63). The minimum and maximum values reflect the wide range of prices, from low-cost species (e.g., 120 DA purchase, 200 DA sale) to high-value species such as Cycas revoluta (purchase up to 40,000 DA, sale up to 60,000 DA).

Table 5. Average purchase and sale price for each species.

Variable	N	DF	Mean	SD	Sum	Min	Max
Min Purchase price (DA)	26	25	2708,4615	7704,587	70420	120	40000
Max Purchase price (DA)	26	25	2768,8462	7691,5701	71990	120	40000
Average Purchase price (DA)	26	25	2738,6538	7697,5538	71205	120	40000
Min Sale price (DA)	26	25	3870	11569,5773	100620	200	60000
Max Sale price (DA)	26	25	4076,9231	11535,417	106000	200	60000
Average Sale price (DA)	26	25	3973,4615	11544,6252	103310	200	60000

Correlation analysis for the purchase and sale prices

The Pearson correlation matrix (presented in Table 6) reveals a strong positive linear relationship among all price variables. All correlation coefficients are above 0.99 ($p < 0.0001$), indicating that purchase and sale prices are almost perfectly correlated.

Table 6. Correlation Matrix

	Min Purchase Price (DA)	Max Purchase Price (DA)	Average Purchase Price (DA)	Min Sale Price (DA)	Max Sale Price (DA)	Average Sale Price (DA)
Min Purchase price (DA)	1,0000	0,9997	0,9999	0,9977	0,9977	0,9984
Max Purchase price (DA)	0,9997	1,0000	0,9999	0,9974	0,9980	0,9984
Average Purchase price (DA)	0,9999	0,9999	1,0000	0,9976	0,9979	0,9984
Min Sale price (DA)	0,9977	0,9974	0,9976	1,0000	0,9973	0,9993
Max Sale price (DA)	0,9977	0,9980	0,9979	0,9973	1,0000	0,9993
Average Sale price (DA)	0,9984	0,9984	0,9984	0,9993	0,9993	1,0000

A scatterplot matrix of the six price variables is presented in Figure 4. The linear pattern observed in each panel visually confirms the extremely high correlations ($r \simeq 1$) reported in Table 5. No obvious outliers or nonlinear trends are detectable.

Regression analysis for the purchase and sale prices

The results of the simple linear regression with average sale price as the dependent variable and average purchase price as the predictor are summarized in Table 7. The intercept was not significantly different from zero (estimate = -127.54 DA, t = -0.93, $P = 0.36$). The slope coefficient for average purchase price was approximately 1.4975 (SE = 0.017, t = 87.88, $P < 0.0001$), indicating that each 1 DA increase in purchase price is associated with an increase of approximately 1.50 DA in sale price.

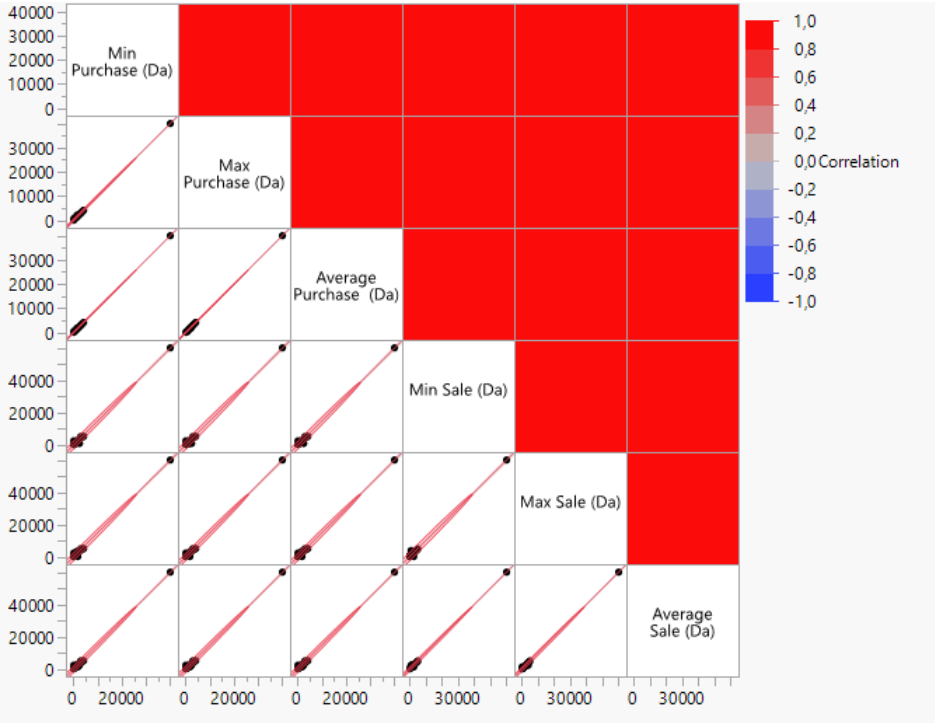

Figure 4. Scatterplot Matrix

Table 7. Parameter estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|	Lower 95%	Upper 95%
Intercept	-127,5448	136,8247	-0,93	0,3605	-409,9371	154,84742
Average Purchase price (DA)	1,4974534	0,01704	87,88	**<,0001***	1,4622842	1,5326225

The model fit statistics are displayed in Table 8. The R^2 = 0.9969, it means that approximately 99.7% of the variance in sale prices is explained by purchase prices. The adjusted R^2 was similarly high (0.9968), and the Root Mean Square Error (RMSE) was 655.84 DA, which is relatively small compared to the mean sale price (3,973.46 DA).

Table 8. Summary of fit

RSquare	RSquare Adj	(RMSE)	Mean of Response	Observations (or Sum Wgts)
0,996902	0,996773	655,8374	3973,462	26

The analysis of variance (ANOVA) in Table 9 confirms the overall significance of the regression model: F (1, 24) = 7722.53, *P* < 0.0001.

Table 9. ANOVA test

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	3321636345	3,3216e+9	7722,533
Error	24	10322943,3	430122,64	**Prob > F**
C. Total	25	3331959288		**<,0001***

The lack-of-fit test (Table 10) was not significant: F (19, 5) = 0.61, *P* = 0.80, indicating that the linear model provides an adequate description of the data and that no significant nonlinearity is present. The maximum possible R^2 given the data was 0.9991, very close to the achieved R^2.

Table 10. Lack of fit

Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	19	7221693	380089	0,6128
Pure Error	5	3101250	620250	**Prob > F**
Total Error	24	10322943		0,8003
				Max RSq
				0,9991

Figure 5 plots the residual average sale prices against the values predicted by the linear model. The points cluster tightly around the identity line (y = x), illustrating the excellent predictive performance of the regression.

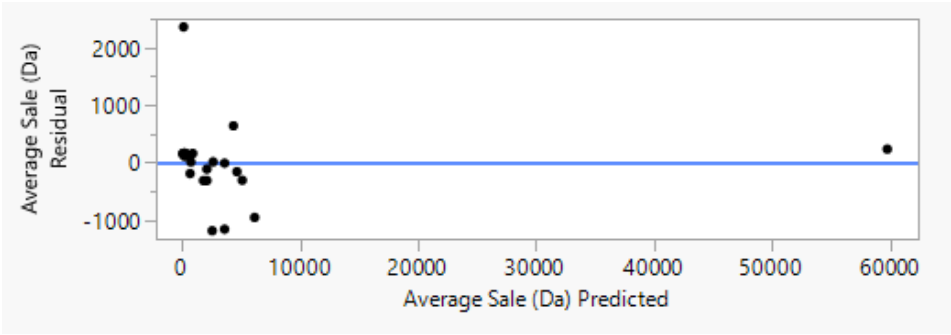

Figure 5. Residual by Predicted Plot

Discussion

Trade in exotic plants has grown significantly in recent years, both nationally and internationally. This practice consists of importing, exporting and market plant species from geographical regions far from their natural habitat. Exotic plants attract attention because of their aesthetic beauty, their unique features and varied uses, ranging from interior ornaments to medicinal applications (Altman *et al.* 2022). Global trade in exotic plants has intensified due to several reasons (Mozer & Prost 2023) such as the expansion of transportation routes and the increased ease of trade international have allowed a more fluid flow of plants across borders.

In addition, the growth of tourism and cultural exchanges has contributed to the popularity of exotic plants, as they are often perceived as exotic memories or unique decorations. This has also given rise to concern and debate. The introduction of exotic species substances may have ecological, economic, and health consequences, including in terms of biological invasion, loss of biodiversity, and spread of plant diseases (Pearson *et al.* 2022). Therefore, it is essential to understand the issues and impacts of this trade to implement sustainable regulations and practices.

In our study, we are particularly interested in the trade in plants exotic in the Batna area. We look at the most common species commercialized and everything that surrounds the subject. Thus, by characterizing and comprising the dynamics of this trade, we aim to provide valuable information for a more efficient and sustainable management of exotic plants in our region. According to our results, the species encountered in the majority of the sites surveyed is *Bambusa vulgaris* Schrad. ex J.C. Wendl. (Bamboo) which is a species belonging to the family Poaceae (grasses) which grows naturally in Asia (such as China, Japan, and other Asian countries). They are characterized in particular by their stems formed of a thatch, generally hollow, lignified, with very rapid growth. It is requested because it is a species adapted to many climates, they are widely introduced to be used as ornamental plants or as a source of fodder, food, or building material, it grows in water and does not need a lot of attention, in addition it is supposed to bring good luck and money. Comparative results were obtained by Dje Bi *et al.* (2017) and Dje Bi *et al.* (2020) which have shown that Bamboo is a widely used multipurpose species in the world in general and particularly in Africa, and more specifically in the Ivory Coast. According to the data in Table 2, the species most present (with the greatest number in the region of Batna) is *Opuntia microdasys* (Lehm.) Pfeiff. Known as cactus, which is present with 248 individuals. It belongs to the family Cactaceae order Caryophyllales and the genus opuntias. It is native to Mexico, Central and South America. According to Maroyi (2022) *Opuntia microdasys* (Lehm.) Pfeiff., is a plant typically used as an ornament, is registered for the first time as a species naturalized in Zimbabwe. Some studies revealed that this species was introduced and naturalized in Australia, Botswana, Namibia, Balearic Islands, Galapagos Islands, Malta, Venezuela, the Canary Islands, France, Italy, Portugal, Spain and Kenya. (Smith *et al.* 2011; Chahdoura *et al.* 2014) confirmed that the bunny ear cactus (*Opuntia microdasys*) was widespread throughout the Mediterranean. We have already noticed that the plant of *Opuntia microdasys* (Lehm.) Pfeiff. (Cactus) has the highest value due to the fact that it is a beautiful looking and non-demanding plant. In addition, its cost is affordable and suitable for many climates. It is widely introduced to be used as ornamental plants.

The species least present are *Pteridium aquilinum* (L.) Kuhn (Fern), *Alocasia macrorrhizos* (L.) G.Don (Elephant Ear), *Epipremnum aureum* (Lind. & André) Bunting, *Philodendron giganteum* Schott (Philodendron), *Stephanotis floribunda* (R. Br.) Brongn. *Stephanotis floribunda* (Br.) Brongn., *Codiaeum variegatum* (L.) A. Juss. (Croton) and the orchid which are present with only 1 individual because they are species of arid areas with hot and dry climate, it does not tolerate the cold. We found

that the lack of sale of these ornamental plants in Batna can be justified by its relatively high price or the fact that it is a sensitive and perishable plant, or that the climate of Batna does not lend itself to it as *Pteridium aquilinum* (L.) Kuhn, or that demand is low, or illegal trade in these species bans like orchids, or perhaps toxic like Elephant Ear *Staghorn Fern.* According to the data in Table 3, the place where there is the greatest number is the « Pépinière ERGR Aurès » with a total of 17 species and a total of 763 individuals, because the exotic plants sold in this area are grown in the nursery and provide the most demanded plants at reasonable prices. On the other hand, the lowest number of species was recorded in the shop « Les Fleures de Batna ». With only 5 species and only 8 individuals because this small shop is attached to a larger shop, « the prince of flowers Khalil ». From Table 4, the most expensive species is *Cycas revoluta*, which is a slow-growing plant forming a trunk over the years of the order Cycadales and the family Cycadaceae. *Cycas revoluta* Thunb. is a very ancient plant that has existed for millennia. Originally from subtropical and tropical regions (Mourya *et al.* 2011). With an average price of 60.000DA because it is a rare species in cultivation and also a very beautiful plant to decorate an interior or an exterior with an exotic touch, its slow growth and the length of the plant is the determining factor of its price. Finally, the demand by the buyers of Batna appears to be the determining factor of its price. However, the cheapest species is *Rosa canina* L. which is a thorny shrub from 1 to 3 meters high that belongs to the family of rosaceas. It is the best-known species of wild roses (Shabih *et al.* 2022). It is native to Europe, Western Asia. *Rosa canina* L. is widespread in the wild but is also cultivated, especially for its ornamental properties. It is mainly used as a rootstock for rose cultivation and adaptation to various terrain (Baconnier 2008). Its average price of 200DA can be explained by the fact that roses are generally in high demand, the cultivation of roses and its adaptation to various fairly common grounds and especially its availability.

According to Frésard (2011), the planting of exotic species, generating environmental and economic damage by threatening ecosystems, habitats and native species, the loss of originality (or authenticity) of the regional flora, following the naturalization of introduced species; biological invasions are considered the second cause of biodiversity loss worldwide, these invasions are the cause of damage not only to the environment, but also to commercial economic activities (e.g. agriculture, with the introduction of pests or new diseases, or to infrastructure, with the introduction of exotic molluscs that damage water pipes and hydroelectric dams and generate considerable control costs) and non-commercial (e.g. recreational activities, with the introduction of aquatic plants that modify the environment and limit fishing and navigation opportunities). The proliferation of diseases poses a major threat to livestock, human health, recreational activities and biodiversity conservation (Morand 2020). Among the known examples we have the elephant ear, an ornamental plant widespread in the homes and gardens of Algerians, which has occupied the first position of poisoning by plants in our country for the last decade, it particularly affects children who generally have mild symptoms, but serious cases have been recorded. However, the general population is still unaware of its risk and most people leave this plant within reach of children (Benamrouche *et al.* 2021).

In our results, the strong linear relationship between purchase and sale prices observed in the region of Batna ($R^2 = 0.997$, slope = 1.497) is in line with broader patterns documented in the international ornamental plant trade. In a recent study, Dawes *et al.* (2026) analyzed over a century of nursery catalogue data in New Zealand and found that naturalized ornamental species were consistently sold at lower retail prices than non-naturalized species, suggesting that price can affect the number of plants introduced into the environment and the associated risk of invasion. It was observed in our study that the strong relationship between purchase and sale prices may reflect a stable market with consistent profit margins. Our result also aligns with a recent study, in which Salazar *et al.* (2025) analyzed the relations about prices of quality-graded agricultural products, and the study results showed that there were strong positive correlations among prices of first-quality products of various market segments based on the type of product and time window. They have demonstrated that in structured markets, the price of high-quality products has tight connections across the distribution channels, just as there is a near deterministic relationship between the sale and purchase prices in the Batna exotic plant market. The high price of Cycas revoluta (60,000 DA) is a good example of how biological characteristics, low growth rate, aesthetic properties, and scarcity in production can be used to charge a high price. Even if our study did not examine the results of invasion, the strong price association shown here offers a baseline to conduct future research in order to monitor further the role of the aspect of pricing in the spread of exotic species in Batna.

Undoubtedly, this study has some limitations. (i) the sampling was restricted to only six shops in Batna city over a short period (December 2022 to April 2023), which limits the representativeness of the findings and does not capture potential seasonal or annual variations. (ii) it was a single and localized work where the findings cannot be applied to the whole country for the moment.

Nevertheless, many prospects for future work or extensions of this work can be cited, for example: Studies on local ecological impact. Indeed, it would be interesting to carry out in-depth studies on the specific ecological consequences of the trade of exotic plants in our region. This could include assessments of the impact on native plant communities, as well as the interactions between exotic plants and the local fauna. Another interesting perspective could be the assessment of sustainable management practices, there is a need to develop sustainable management approaches for trade in exotic plants. Further studies may focus on identifying best practices, such as certification standards for producers and distributors, consumer awareness, as well as control and surveillance measures to prevent the introduction of invasive species. Finally, it would be interesting to realize an in-depth economic analysis, including the fact of understanding the economic dimensions of trade in exotic plants is essential for informed decision-making.

Finally, future studies could also focus on analyzing financial flows, value chains, and economic costs and benefits associated with this trade. We think that this would help to assess the economic impact on local communities, to identify sustainable business opportunities and to promote responsible use of resources. In addition, it may be interesting to monitor and evaluate policies and regulations, as it is important to monitor effectiveness existing policies and regulations on trade in exotic plants because it may assess the application of laws, the effectiveness of control measures, and policy impacts on trade sustainability. This information could serve as a basis for improving regulatory policies and practices.

Conclusion

This study aimed at investigating and drawing-up a list of exotic plants and to examine the most commonly traded species in the city of Batna and all that that surrounds the subject and provide valuable information for more effective management and sustainable exotic plants in our region. Depending on the nature of the plant sales sites, these are flower shops and only two of the six sites surveyed are nurseries.

All the data analyzed from florists in the city of Batna gave us the opportunity to record a list of species and the purchase and sale price of each. The results obtained are original and are characterized by: First, a total of 35 species and 1137 individuals with a minimum of 1 and a maximum of 195. Then, the nursery the brothers Bloum-Tazoult and the nursery ERGR Aurès are those with the most species and the shops « Le coin vert Fesdis » and « Pépinière ERGR Aurès » are the ones where the average number of individuals is the highest. Regarding species, *Opuntia microdasys* (Lehm.) Pfeiff. « cactus » is the species with the largest population in the region of Batna presented with 248 individuals, while *Cycas revoluta* Thunb. is the most expensive species to an average price of 60,000 DA. At the same time, *Bambusa vulgaris* Schrad. ex J.C. Wendl. (Bamboo) is the most exotic encountered in the majority of florists surveyed. To the best of the author's knowledge, it was the first study of this type carried out in the region of Batna. In terms of statistical results, our correlation analysis indicated a highly significant linear relationship between purchase and sale prices, while the regression analysis confirmed this relationship, indicating predictable prices in the exotic plant market of Batna.

In addition to its originality, we think this study can be seen as a foundation for future work because, as has been pointed out before, this is a sampling that was done in a given time in a given place. Therefore, it is impossible to draw general conclusions in relation to this work. On the other hand, our results are excellent beginnings for the realization of future work in this direction in order to better characterize the situation over several years, to study the possible impact of the introduction of these exotic species on our ecosystem. Consequently, we cannot claim to answer totally to the stated problem. Objectively, several samples must be taken in different areas at different times to obtain more results.

At the end, it will be important to intensify studies on the local ecological impact, such as by carrying out in-depth studies on the specific ecological consequences of trade in exotic plants in our region. It would also be interesting to include in-depth assessments of biological invasion by certain exotic species, their impact on native plant communities, as well as interactions between exotic plants and local fauna.

Declarations

List of abbreviations: ANOVA – Analysis of Variance.

Ethics approval and consent to participate: Not Applicable.

Consent for publication: Not applicable.

Availability of data and materials: Data for this study is available from the corresponding author upon request.

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Author contributions: F.K.K and A.B: Conceived the idea, collected data, and wrote the first Draft of the manuscript. M.A carried out the data analysis, Reviewed and Edited. H.A.A: Conceived the idea, Reviewed and Edited, Validated and Supervised the work.

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