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Ethnobotany and perceptions on the value of taro (*Colocasia esculenta*) among farmers in Benin Republic

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Taro (*Colocasia esculenta*) is a widely grown vegetatively propagated food crop in the Benin Republic. The taro leaf blight (TLB) epidemic in 2009, caused by *Phytophthora colocasiae,* has destroyed taro production and wiped out many taro landraces in West Africa. A survey was conducted in the southern region of Benin to assess the status of taro and TLB, ethnobotany, farmers' perceptions of taro, and identify production constraints. A structured questionnaire was used to collect information from 24 farmers in 17 villages across six departments, and the TLB incidence was assessed in the same fields. The results revealed the prevalence of TLB across all the villages and a sharp reduction in production since the TLB epidemic. The TLB incidence ranged from 25 to 100%, however, the mean symptom severity score per field assessed on a 1 to 5 rating scale varied between 0.25 and 2.8. Awareness about the TLB or good crop management practices was low. Integrated methods for TLB control and improved agronomic management are crucial to enhance taro yields. In the long term, introducing resistant varieties is critical for the sustainable management of TLB and taro production in Benin.

Key words: Taro, taro leaf blight, *Phytophthora colocasiae*, ethnobotany, Benin, Africa.

INTRODUCTION

Taro (*Colocasia esculenta*) is a tropical root crop propagated vegetatively and is native to Southeast Asia (Dastidar, 2009; Matthews and Nguyen, 2014). It is the 9th most widely grown food crop in the world, with cultivation throughout Africa (Oladimeji et al., 2022; Rashmi et al., 2018). The corms and flowers are utilized in dishes in West Africa (Grimaldi, 2016), and their sociocultural, historical, and spiritual significance is highly valued in Oceania and the Pacific (Grimaldi, 2016). In several parts of Africa, including Cameroon and Kenya, the corms of various taro cultivars are used medicinally to treat digestive and respiratory problems in both people and

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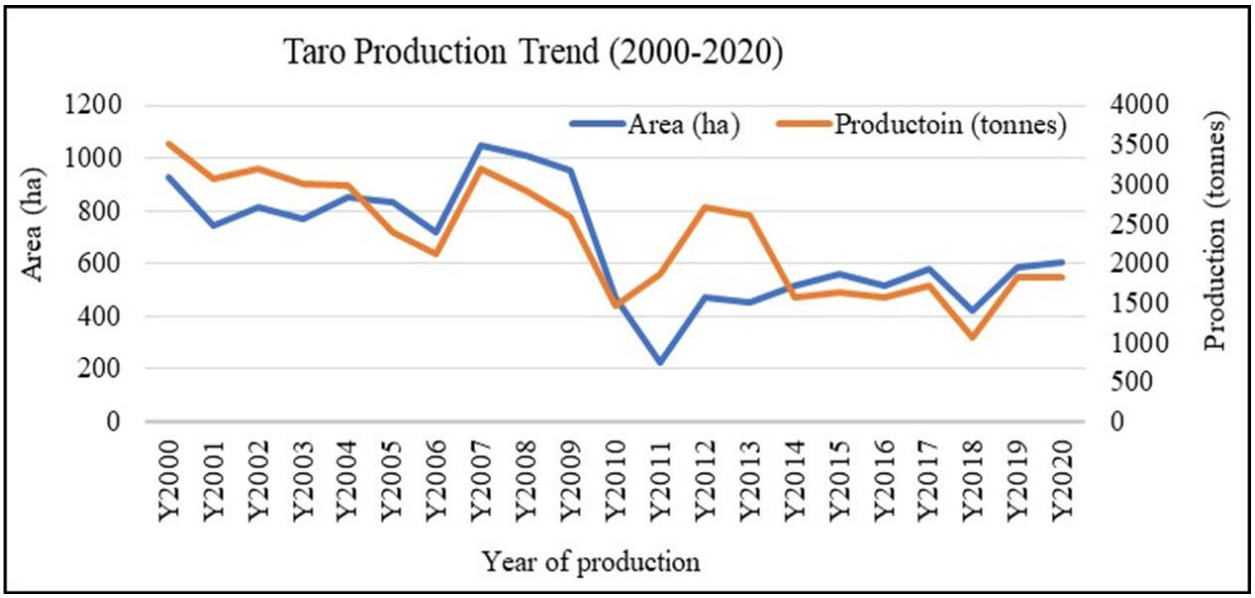

Figure 1. Taro production trend in Republic of Benin between 2000 to 2020.
Source: This study

animals, as well as diabetes in Nigeria and the Democratic Republic of the Congo. Despite the economic importance of taro, ethno-botanical data on this crop in certain geographical areas of West Africa is still scant (Grimaldi et al., 2018). Several vernacular names exist due to differences in ethnicity (Grimaldi et al., 2018).

Taro is the second most important root and tuber crop in the Benin Republic, after yam, followed by sweet potato and cassava in consumer preference (Houngbo et al., 2015). However, its production has been declining for some time (Figure 1). For instance, from 2000 to 2020, the production area dropped from 925 to 608 ha and from 3,518 to 1,837 tonnes, with the lowest output of 1,069 tonnes in 2018 (FAOSTAT, 2022). The average yield of the crop during this period was 3.7 t/ha, which is about 50% lower compared to a world average of 7.3 t/ha or the African continent average of 6.4 t/ha for the same period (FAOSTAT, 2022).

Taro is adopted as an accessory crop in the southern part of Benin, ahead of crops such as maize and cassava (Houngbo et al., 2015). Two taro varieties are being used in Benin. Tôglin in Fon, grown in swampy areas, is more prevalent in the southern and central departments of Ouémé, Zou, Plateau, and collines (the Nago cultural area) and Boukoumbé and Malanville in the northern region. It produces large tubers and tiny, light-green leaves. Another cultivar lacks a specific common name and is widely grown in firm soils in the southern regions, especially in the Ouémé valley (Dansi, 2006). It has small tubers with the relatively high dry matter, large dark green leaves, and good-quality paste when the tubers are mashed (foutou).

Although taro is highly valued, its production is affected by several biotic and abiotic constraints. Taro Leaf Blight (TLB), caused by *Phytophthora colocasiae* Raciborski, is a major taro disease, responsible for about 50 to 95% of the loss of taro production (Otieno, 2020; Wondimu et al., 2021). The disease was first observed in West Africa in 2008 to 2009 and led to a 60% decline in the production in several countries (Bandyopadhyay et al., 2011; Omane et al., 2012; Tsopmbeng et al., 2012; Mbong et al., 2013). The TLB pathogen has spread widely in sub-Saharan Africa (Ugwuja et al., 2020). Despite the widespread destruction of TLB in the Benin Republic, information on TLB and its impact on production are lacking. Therefore, this study was conducted to assess the incidence and severity of TLB in major taro production agro-ecologies in the southern Benin Republic. The survey also focused on identifying the main constraints to taro production, farmers' perception of crop value, and the ethno-botany and uses of taro to develop suggestions for the revival of the crop.

MATERIALS AND METHODS

Description of the survey area

The survey was carried out between July 2021 and January 2022 in the southern region of the Benin Republic (Table 1 and Figure 2). The surveyed region is situated between the latitudes of 6° 15' and 7° 30' north and the longitudes of 1° 52' and 2° 36' east. It has a subequatorial climate with two rainy seasons interspersed by two dry seasons, covering an area of 17,019 km^2, predominantly covered by vertisols (Akplogan et al., 2018). Rainfall and temperature in this area range between 1100 and 1400 mm and 26 to 28°C, respectively. Seventeen villages were covered in six departments among six ethnic groups. Eighteen farms were surveyed to evaluate TLB disease incidence and severity. The

Table 1. Departments, communes, and villages surveyed in Benin in 2021-2022

Department	Commune	Village*	Longitude	Latitude	Altitude (masl)	Number of farmers interviewed
Plateau	Ketou	Sodji	7.4071536°	2.3657571°	158	2
Plateau	Pobe	Issaba	7.0900733°	2.4944655°	57.1	1
Plateau	Sakete	Illako	6.7949883°	2.6603717°	31	2
Zou	Zangnanado	Dovi-Zounnou	7.1198252°	2.3657571°	15.2	5
Oueme	Adjohoun	Sissekpa	6.6868552°	2.4983372°	13.8	1
Oueme	Adjohoun	Kpodedji	6.6763642°	2.4983372°	11.2	1
Oueme	Bonou	Hounvigue	6.8013336°	2.4769372°	10.3	1
Couffo	Dogbo	Ahomey	6.7974773°	1.7469948°	39.6	1
Couffo	Dogbo	Ahomey	6.8063417°	1.7474917°	39.4	1
Atlantique	Toffo	Sehoue	6.928847°	2.263769°	52	1
Atlantique	Ze	Hekanme	6.752103°	2.331558°	30	1
Atlantique	Ze	Awokpa	6.789025°	2.301791°	30	1
Atlantique	Ze	Sedje Houegoudo	6.732794°	2.370885°	7	1
Atlantique	Abomey-calavi	Kpanroun	6.683783°	2.363411°	18	1
Mono	Athieme	Kpinnou-zongo	6.584630°	1.767386°	13	1
Mono	Lokossa	Zongo 2	6.631564°	1.717831°	40	1
Mono	Lokossa	Hoin	6.630164°	1.752997°	15	1
Mono	Lokossa	Lokossa-centre	6.644244°	1.712069°	33	1
Total						24

Source: This study

study was conducted through interviews with taro producers using a questionnaire (Supplementary file 1).

Survey questionnaire and protocol of data collection

A questionnaire was formulated as per the Nkengla-Asi et al. (2021) to collect information on socio-economic status, ethno-botany, and uses of taro, and constraints to taro production, and the IPGRI's Taro descriptors (1991) was adopted to identify taro varieties in the field. Four markets were visited as part of the survey to collect information on quantities of taro sold, taro demand, amount of corms per kilogram, quantity sold, time of sale, and source of the taro sold ((Supplementary file 2).

Assessment of TLB

TLB in the farmers' fields was assessed based on the symptoms. TLB incidence in a field was estimated by assessing symptoms on 20 random plants, and percent disease incidence was calculated as per the formula given (Adinde et al., 2016).

A visual scale of 0 to 5 was used to assess the severity of the disease, with 0 = no symptom; 1 = low infection (1 to 25% infection on leaf); 2 = moderate infection (26 to 50% infection on leaf); 3 = high infection (51 to 75% infection on leaf); 4 = very high infection (>75% infection on leaf).

Data analysis

A descriptive statistic was done using MS Excel, and frequency distribution and percentages for each parameter were evaluated. Before analysis, the respondent's answers were scored in a binary and multi-scaling fashion depending on the variable.

RESULTS

Socioeconomic status of taro farmers, land area and cropping system

Most surveyed farmers were men, representing 95.9%, and only 4.1% were women (Table 2). The respondents' ages varied between 23 and 81 years. The most encountered age category is 20 to 40, which accounts for 45.8% (Table 2). The largest household size means (8) was within the age category of 41-60 (Table 2). The source of income was based on the crops produced, which varied from one farmer to another and comprised tomato, maize, tannia, rice, taro, cassava, sugar cane, pineapple, fishery, and non-agricultural activities. Most taro farmers are producing rice (25%), followed by maize and tomato (16.6%), respectively (Table 3).

Ethnobotany and uses of taro

Two varieties of taro were found in the surveyed fields, the dasheen type and the eddoe type (Figure 3). Six sociolinguistics groups were encountered, including Fon, Goun, Yoruba/Nago, Kotafon, Adja, and Aizo. The dasheen type, which is known under four different names, was the most found. Tôglin, which means "tuber that grows in the water" from the ethnic group Fon, was the most popular common name for taro. Other local names were Bangali from the ethnic group Adja, "Ikoko"

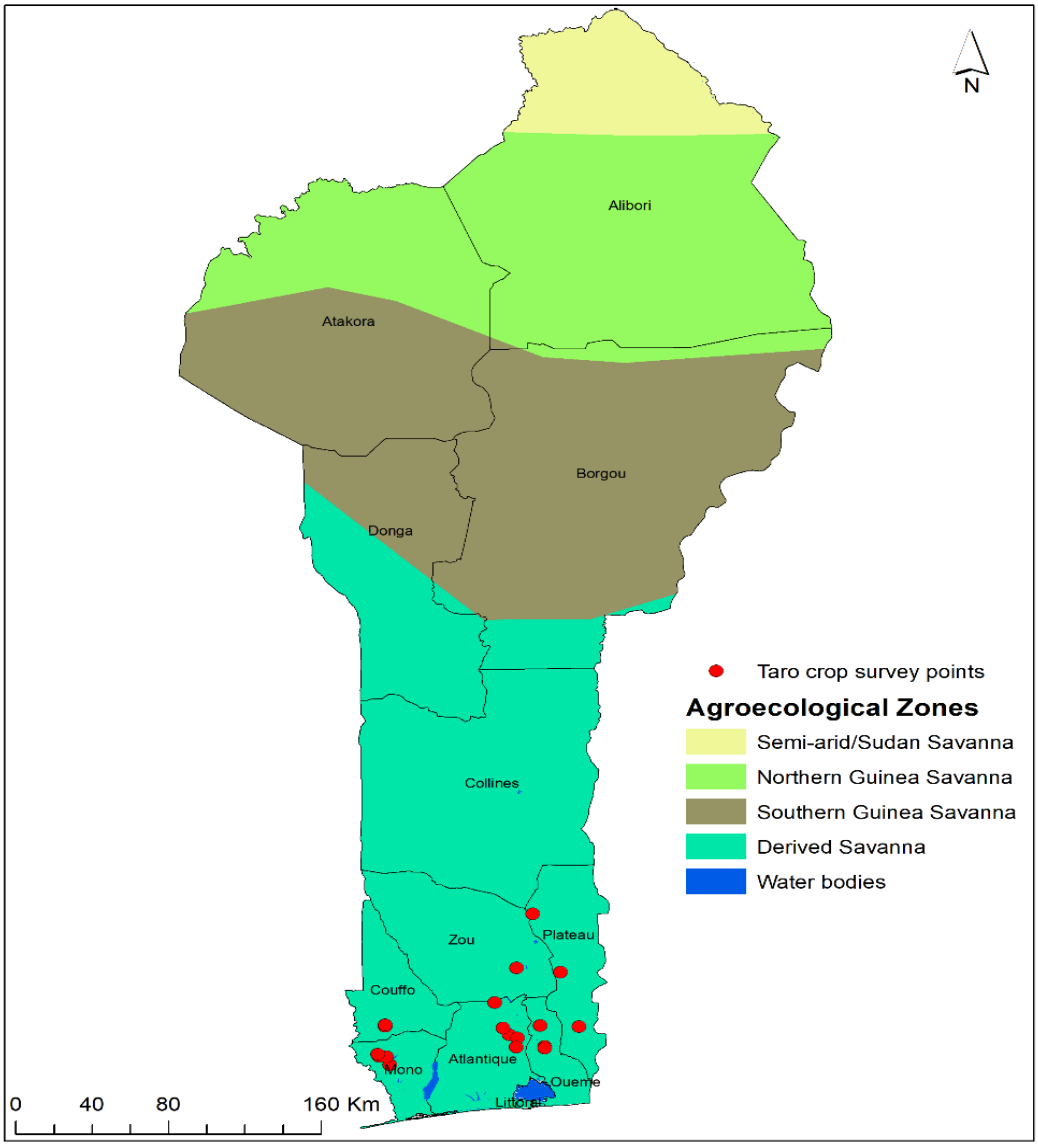

Figure 2. A map of taro farms surveyed in southern region of Benin Republic.
Source: Map developed by the Biometric Unit of the International Institute of Tropical Agriculture (IITA), Ibadan, Ibadan, Nigeria.

for the Yoruba, and Ahoviglin from the Aizo, which means "reserved for prestigious people". Respondents were uncertain about the year of introduction, but many in the commune of Zangnanado were growing the crop for over 40 years. Similarly, some farmers encountered in the districts of Bonou related the provenance of the crop to Agonlin-Zangnanado in the department of Zou, one of the regions where the dasheen type is often found (Dansi, 2006).

Taro is used for nutrition, medicine, and for ceremonies. The corms, young leaves, and petiole are all consumed. The corms are boiled, fried, pounded, and processed into chips and the flour is incorporated into children' food. Taro is used for rituals at Savalou, one of the communes in the department is called "Les Collines". Taro is available throughout the year depending on the locality and the planting time. It is planted in February and harvested in October in the department of Mono; in the department of Atlantic, it is planted in December-February and harvested in October; in the department of Zou, taro is planted in January-April and is harvested in November and December. In the plateau, the crop is planted in January and harvested in December while in Oueme department; it is planted in March and harvested either November or December. This shows that taro is harvested almost at the same time (dry season) in all growing regions but the differences in planting time may be related to the variation in the maturity of the varieties

Table 2. Gender, household size and age category of the respondents.

Gender	Frequency	Percentage
Male	23	95.8
Female	1	4.2
Total	24	100
Household size		
1*5	10	41.7
6*10	12	50
11*15	2	8.3
Total	24	100
Age category		
20-40	11	45.8
41-60	10	41.7
61-80	3	12.5
Total	24	100
Age group	**Mean household size**	
20-40	5.9	
41-60	8	
61-80	6.7	

Source: This study

Table 3. Source of income of respondents.

Source of income	Frequency	Percentage
Maize	4	12.5
Tomato	4	16.6
Rice	6	25
Pineapple	1	4.1
sugar cane	1	4.1
Non –agriculture	3	12.5
Cassava	2	8.3
Tannia	1	4.1
Taro	1	4.1
Fishery	1	4.1

Source: This study

and environmental conditions peculiar to each location. However, some farmers claimed that there is no precise planting time; taro is planted depending on the availability of the planting materials. Twenty nine percent of the producers cultivate taro for its high market value compared to other tuber crops such as tannia (*Xanthosoma sagittifolium*). Certain respondents valued the crop because of its good taste. This parameter accounts for 20.8% (Figure 4).

Farmers interviewed have 3 to 29 years of experience in taro production and it was observed that the same land had been used for years. Rotation is less practiced due to the growing conditions required by the crop. Most producers (63.6%) use saved corms for replanting (Figure 5). The source of the planting materials can play a significant role in the spread of the disease and the survival of the pathogen. Taro was cultivated as monoculture by 30.4% farmers, and intercropping accounts for 69.6% (Figure 6). Taro is associated with other crops such as rice, maize, vegetables, etc. The amount of land devoted to taro cultivation was small and varied from 0.01 to 0.4 ha (Figure 7).

Constraints to taro production

Farmers enlisted many constraints to taro production. The scarcity of taro producers was attributed to decreased land use for taro production (Figure 7). Other constraints were a lack of financial support, low productivity, diseases and pests, climate change, and agronomic issues (Figure 8). However, farmers faced no major difficulties in marketing corms except for the reduction of the corm size observed after the outbreak of TLB. The production trend of taro observed in the study area from 2017 to 2021 (Figure 9) shows that the production volume has decreased due to the decrease in the taro production area and the farm size (Figures 1 and 7). Twenty-seven percentage of the farmers mentioned that their production had been approximately the same between 2009 and 2020, while 18% stopped producing taro, and only 4.5% claimed an increase in production. Among the constraints listed by farmers, TLB constituted the major threat, and most of the farmers interviewed did not know about measures to combat the TLB disease. A few (4.5%) mentioned using fungicides without getting satisfactory results. Farmers expressed interest in adopting new strategies to combat the disease and are willing to destroy the existing infected plant materials.

Farm stresses and risk likelihood

The results of the disease incidence and severity of TLB in the seventeen villages are presented in Table 4, and TLB symptoms observed in farmers' fields are as shown in Figure 3E to H. The result showed that the highest disease incidence (100%) was observed in nine locations, while the least was observed in four villages (25%). The disease incidence in other villages ranges from 35 to 85%. The disease severity score in the field ranged from 0.25 to 2.85. The highest mean severity score of the field was 2.85 and was observed in Hoin, which also showed the highest disease incidence (100%). Similarly, in Zounnou, the severity score of the field is 2.8, and a disease incidence of 100% was also recorded. A higher incidence of TLB is observed in areas where taro was grown in marshy and waterlogged soils. This includes the villages of Ioannou, Sissekpa, and

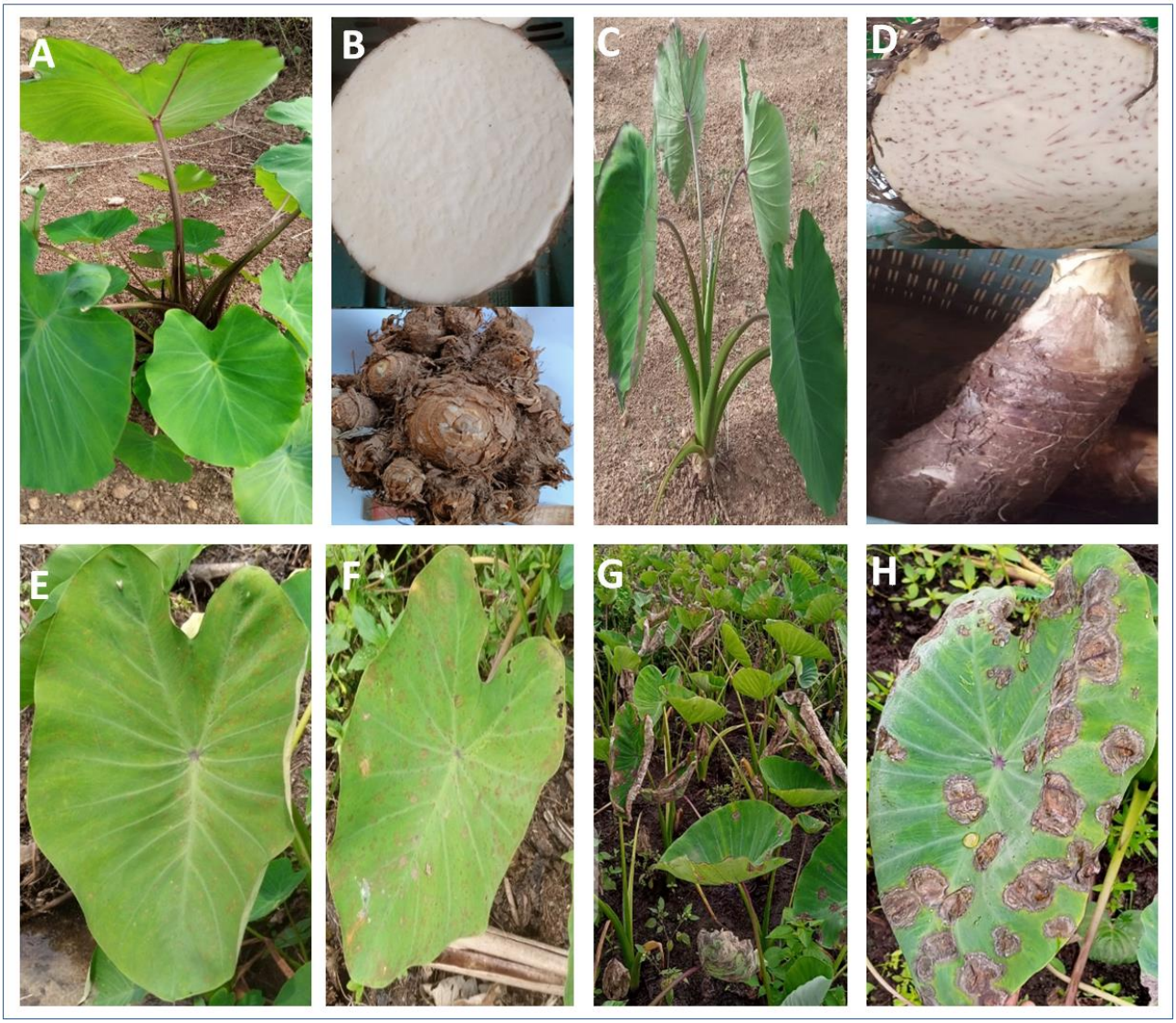

Figure 3. Variation in petioles and corms flesh color of taro varieties found in Issaba village and Sissekpa in Benin Republic. (A): *Colocasia esculenta* var. *antiquorum* (eddoe type), (B): corm flesh color and whole corm of the eddoe type, (C): *Colocasia esculenta* var. *esculenta* (dasheen type), (D): corm flesh color and whole corm of the dasheen type; and (E-H): taro leaf blight (TLB) symptoms, (E): mild infection, (F): moderate infection, and (G & H): severe infection.
Source: This study

Hounvigue. TLB incidence was low in the villages of 'Ketou-sodji' and 'Ketou-Issaba,' where the areas were dry and not flooded (Table 4). TLB severity was low in 29.41% of the fields, moderate in 17.6% of the fields, and high in 52.9% of the fields.

DISCUSSION

The findings of this survey suggested that taro is cultivated as an intercrop between (with rice, banana, maize, tannia, and vegetables) 7 to 158.4 masl in the southern region of the Benin Republic. Akplogan et al. (2018) reported that farmers use many criteria to distinguish between the varieties, which are leaf color, petiole color, skin color, and bud color of the corm. According to Dansi (2006), the eddoe type has large dark green leaves and relatively smaller corms with high dry matter content, while the dasheen type is characterized by small light green leaves with large corms. The two most commonly grown taxonomic variants of *C. esculenta* known as *C. esculenta* var. esculenta and *C. esculenta* var. *antiquorum* (Ubalua et al., 2016) have been found in the study area. The dasheen type, *C. esculenta* var. *esculenta* is characterized by a large central corm with suckers and stolons and few cormels, whereas the

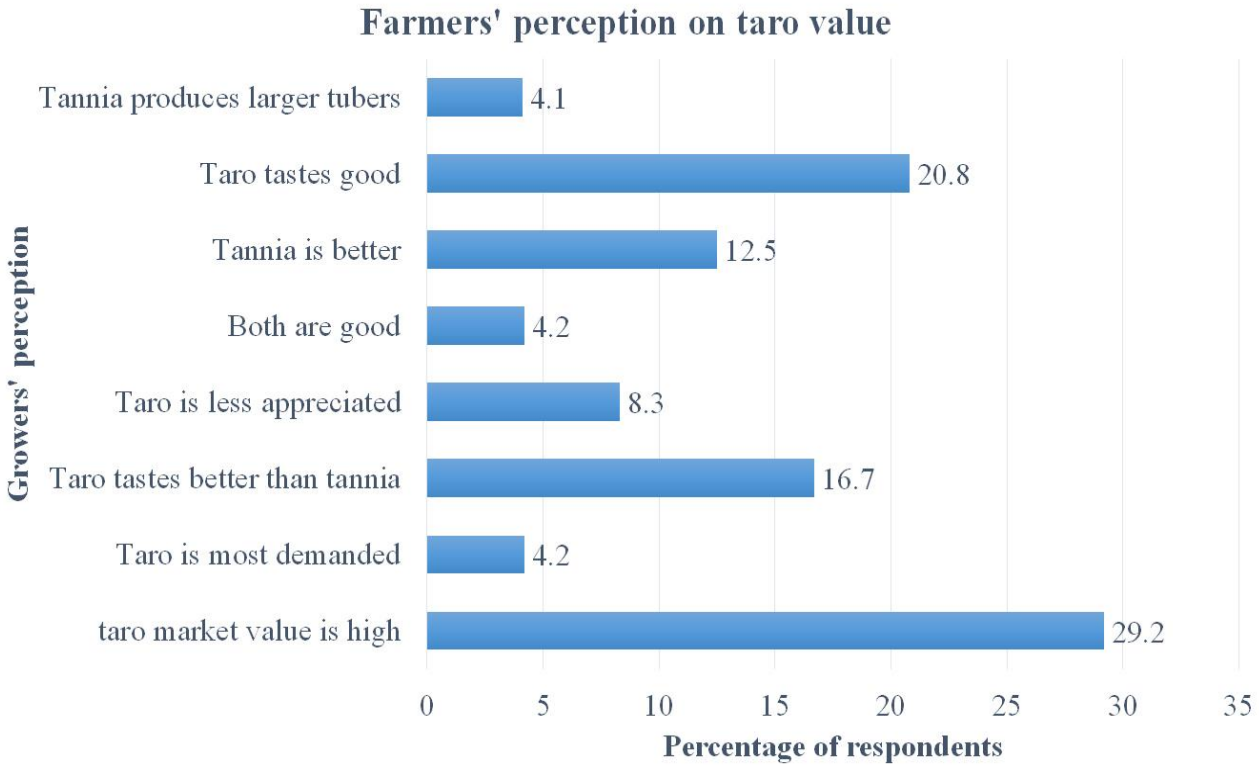

Figure 4. Perception on the value of taro compared to tannia (*Xanthosoma sagittifolium*) among farmers in the southern Benin Republic.
Source: This study

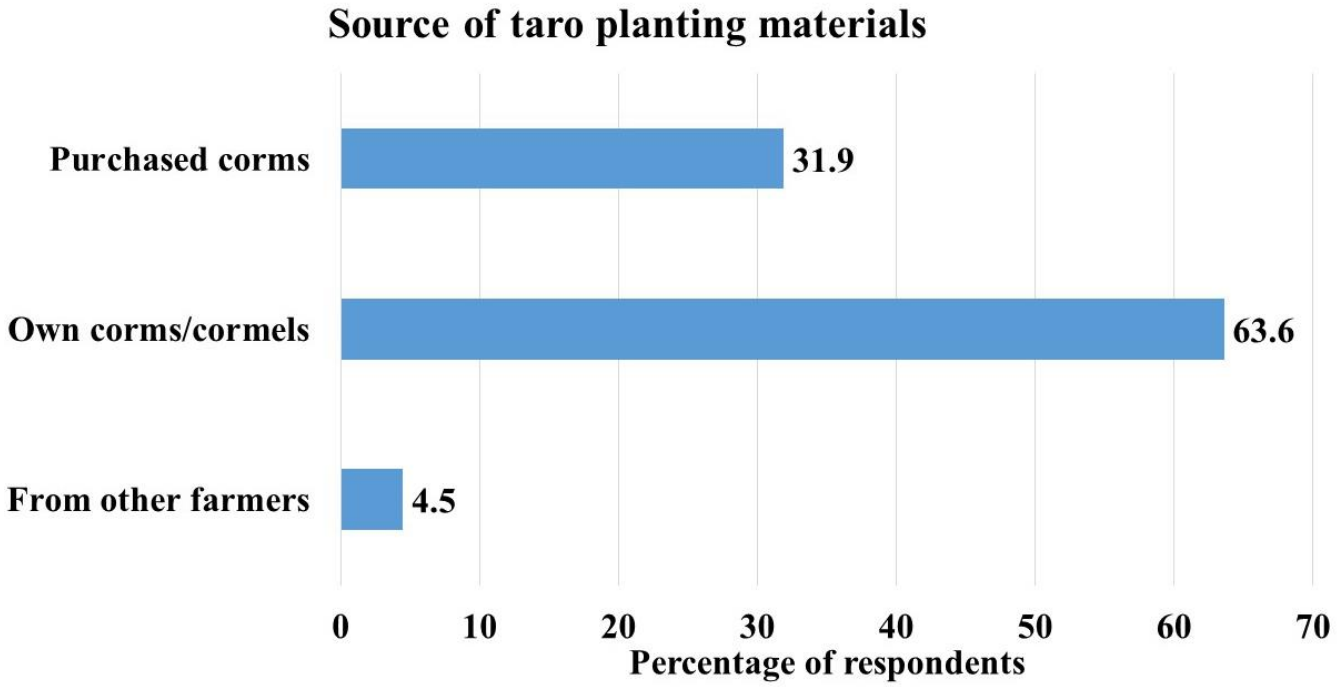

Figure 5. Sources of taro planting materials in southern Benin Republic.
Source: This study

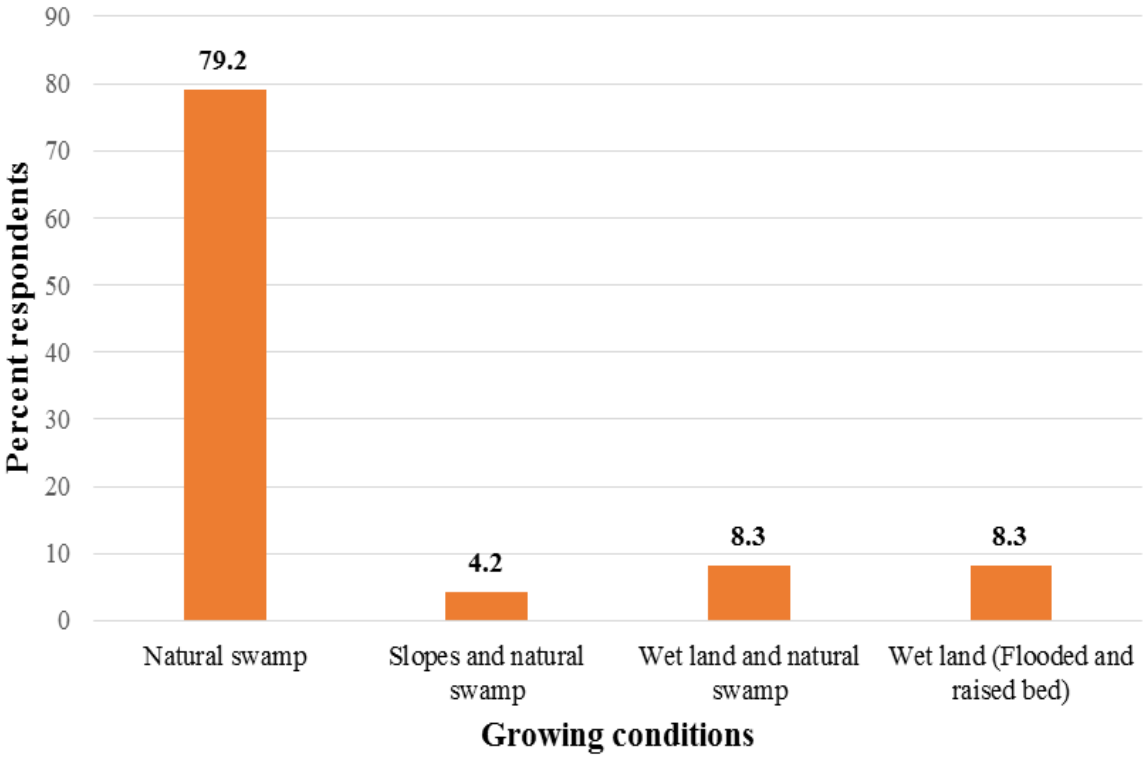

Figure 6. Taro growing environments in southern Benin.
Source: This study

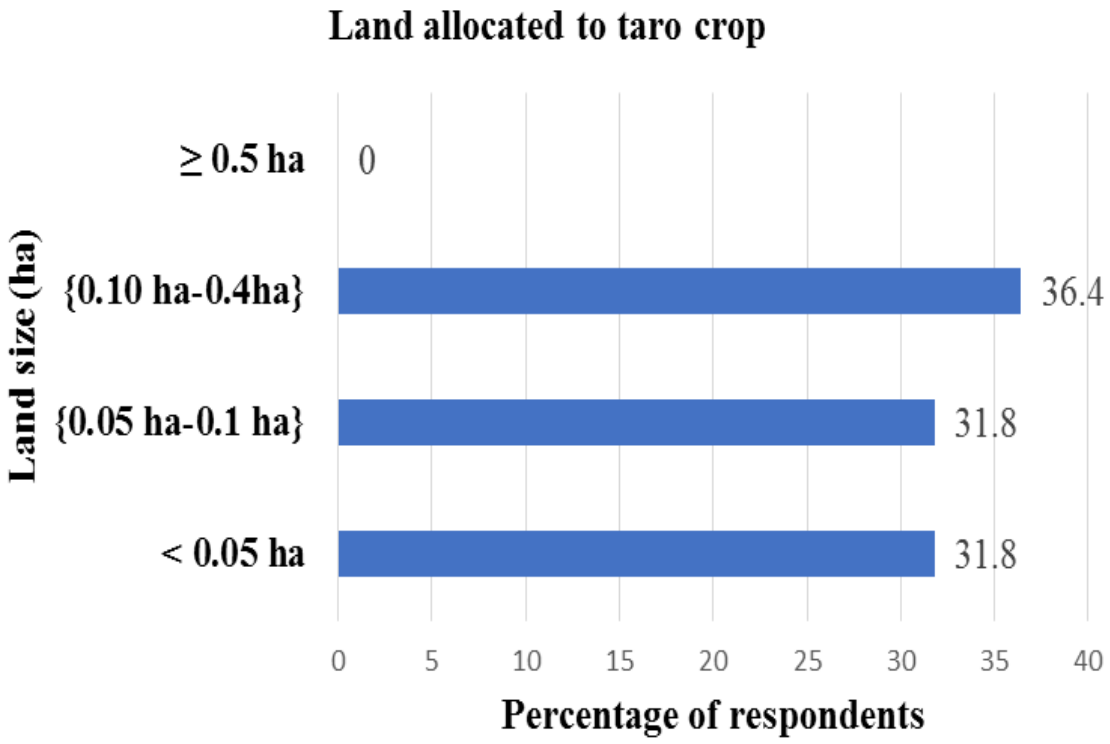

Figure 7. Typical **s**ize of the taro farm in the study area.
Source: This study

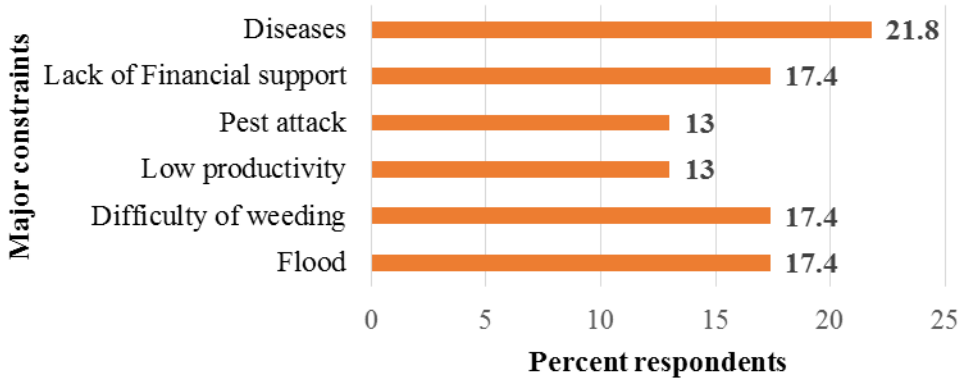

Figure 8. Major constraints in taro production among farmers in Benin.
Source: This study

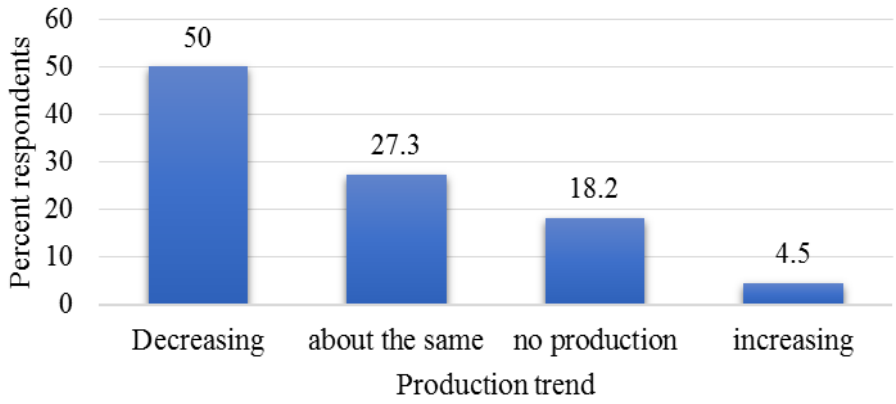

Figure 9. Trend of taro production from 2017-2022 among the farmers assessed in Benin.
Source: This study

eddoe type, *C. esculenta* var. *antiquorum* has a small central corm and many smaller cormels (Dai et al., 2016; Mace and Godwin, 2002). The difference between these cultivars is found in the color of the leaves and the color and shape of the corm, the petiole color, and the bud color (Achigan et al., 2010; Houngbo et al., 2015; Akplogan et al., 2018). Since they correspond to two different commercial types, the distinction between dasheen varieties and eddoe types is useful (Quero-Garcia et al., 2004). The dasheen variety appears to be the most preferred taro due to its flavor, taste, high market value, and short cooking time (5-25 min).

The petioles and young leaves are consumed as vegetables, and the corms are boiled, fried, roasted, or pounded in the study area, generally in West Africa (Mwenye, 2009). In the study area, taro corms are also processed into chips, and the flour is incorporated into food for the children. The two main characteristics the farmers indicate for the value of taro corms are the high market value of the corms and the organoleptic properties, especially the taste. Farmers' perceptions revealed in this study showed that taro is a highly valued product, as confirmed by Houngbo et al. (2015). In Hawaii and other Pacific islands, taro is used to make baby food due to its small and easily digestible starch (Palanisamy et al., 2018). The crop is involved in rituals in Savalou (one of the well-known districts of yam production in the center of the country). Taro is not popular in all the areas visited, especially in the department of Mono, where among nine farmers questioned in 9 villages, 50% of the interviewees revealed they do not know about its value. Further, 22% did not eat it and said that taro is found naturally in nature. The low popularity of taro could be related to the acridity in certain varieties and lack of unawareness of its food use and nutritional value.

In the Benin Republic, many names have been given to refer to taro. Farmers provided four vernacular names, varying from one ethnic group to another for the same variety. The Yoruba and the Nagos name it Ikoko, the

Table 4. Incidence and severity estimation of TLB in 17 villages in Benin Republic.

Department	Commune	Village	Incidence (%)*	Severity score of the plants	Severity score of the field
Plateau	Ketou	Sodji	75	1.7	1.3
Plateau	Ketou	Issaba	25	1.0	0.3
Plateau	Sakete	Illako	35	1.0	0.4
Zou	Zangnanado	Dovi-Zounnou	100	2.8	2.8
Oueme	Adjohoun	Sissekpa	75	3.7	2.8
Oueme	Adjohoun	Kpodedji	50	1.0	0.5
Oueme	Bonou	Hounvigue	85	2.7	2.7
Couffo	Dogbo	Ahomey	25	1.0	0.3
Couffo	Dogbo	Ahomey	25	1.0	1.0
Atlantique	Toffo	Sehoue	100	1.7	1.7
Atlantique	Ze	Hekanme	100	2.6	2.6
Atlantique	Ze	Awokpa	100	2.4	2.4
Atlantique	Ze	Sedje Houegoudo	100	2.3	2.3
Atlantique	Zinvie	Kpanroun	100	1.9	1.9
Mono	Athieme	Kpinnou-zongo	25	2.6	2.6
Mono	Lokossa	Zongo 2	100	2.7	2.7
Mono	Lokossa	Hoin	100	2.9	2.9
Mono	Lokossa	Lokossa-centre	100	2.6	2.6
Plateau	Ketou	Sodji	0	0.0	0.0
Plateau	Ketou	Issaba	0	0.0	0.0
Zou	Zangnanado	Dovi-Zounnou	100	1.8	1.8
Oueme	Adjohoun	Sissekpa	55	1.5	0.9
Oueme	Bonou	Hounvigue	60	1.6	1.0
Mean			*66.7*	*1.8*	*1.6*

*Based on 20 plant assessment per field.
Source: This study

Gouns and the Fons call it Toglin, the Aizos name it Ahoviglin, and the Adjas call it Bangali. The Fons and the Adjas are the largest ethnic groups in the south of the country (Sanni, 2017). Together, the Fons, Adjas, Gouns, and Nagos/Yoruba represent about 35% of the total population. It has been noticed that the taro producers surveyed are among the most widespread ethnic groups in the south of the country.

Out of the 24 farmers questioned, only one (4.1%) was found to have taro as the main source of income. This funding suggested that despite its economic value, taro is grown as a minor crop in the Benin Republic and is not a priority crop for the farmers (Houngbo et al., 2015; Akplogan et al., 2018). Factors such as gender, age, land size, and access to credit have significant influence, although their degree of influence varies from study to study (Okoye et al., 2009; Tumuhimbise et al., 2016). Furthermore, it was hypothesized that the production of taro has a monetary value and that men typically predominate in the cultivation of such crops. This may be explained by their easier access to land and the high value of taro in the market (Tumuhimbise et al., 2016). Women are not much involved in taro production in the Southern part of Benin republic. This situation was also observed in Togo (Bammite et al., 2018) and was reported in Nigeria (Amusa et al., 2011) and Uganda (Tumuhimbise et al., 2016). The most encountered age category was 20 to 40. People in this age range are more productive and can acquire new agricultural extension principles and use them to increase crop yield. Compared to older farmers who may be more experienced, young farmers are most willing to welcome new changes in the agricultural system, such as introducing new varieties.

Akplogan et al. (2018) indicated that the cultivation area varied between <10,000 and 30,000 m^2. Compared to the results of this investigation, where the taro farmland ranges from 150 to 4230 m^2, which implies a reduction in the area of production of taro in Benin. About 80% of the farmers interviewed in the commune of Zangnanado, district of Dovi, especially in the village Zounnou (a well-known area of taro production in the southern region), revealed that they do not produce because of TLB. This disease has led to a drastic decrease in taro production, abandonment of lands allocated to its production, and replacement of the crop with rice was observed in another village called Bame in the same department (Otekunrin et al., 2021). Similar constraints were reported by Houngbo et al. (2015), who

mentioned that the low productivity was due to many factors. The most significant is the lack of healthy planting materials. As observed in this study, taro is a marginal and little-documented crop in the Benin Republic. The same situation was observed in Côte d'Ivoire (Koffi et al., 2021). Certain farmers claimed that their total production, which could be estimated at tons before the outbreak of TLB, is now reduced to some kilograms. This highlighted the scarcity of the crop in the study area and may explain its absence in the respective visited markets. It has been reported that TLB can cause yields to drop by 25 to 95% in taro-growing nations (Sharma et al., 2008), which explains why many growers ignore the crop, leading to significant changes in diets and cropping methods in impacted areas (Okereke, 2020; Njideka et al., 2021).

TLB outbreak resulted in a drastic reduction in production level and farmland size in the southern part of Benin. It has been reported that taro is affected by many diseases and pests in many places of the world (Ayogu et al., 2015), especially *P. colocasiae* (Sarkar et al., 2017; Wondimu et al., 2021). This disease, which is the most devastating, caused economic losses of more than US$1.4 billion during the TLB pandemic and significantly impacted the genetic diversity of the local gene pool of the plant (Onyeka, 2014). Furthermore, the taro farmers in certain regions in the study area have abandoned taro production, and replacement by rice was made as farmers found no effective means to control the disease. In Cameroon, the same situation has been reported in certain regions, indicating that farmers abandoned taro production due to TLB (Mbong et al., 2013). In the Pacific, it has been shown that chemicals and cultural practices against TLB are largely ineffective (Sarkar et al., 2017).

All farms surveyed in this study recorded above 20% disease incidence, and the highest disease incidence of 100% was recorded in 9 locations (50%) among 18 surveyed farms. The widespread disease may be explained by the high humidity and hot weather temperatures, which create the perfect conditions for the spreading and multiplication of the pathogen (Sarkar et al., 2017; Dossou et al., 2021). The incidence and severity of TLB observed in farms in Zounnou, Sissekpa, Hoin, and Hounvigue seem to be positively correlated, as the highest disease incidence and severity were recorded in each of these locations. This finding is corroborated by Sarkar et al. (2017), who demonstrated that the highest mean Percent Disease Index (PDI) of 20.74 observed in the susceptible cultivar Telia showed a significantly increased blight incidence compared to other cultivars. The market survey conducted in four major taro markets in the study area revealed the absence of taro corms and the scarcity of taro sellers. In the majority of taro-producing nations, it has been reported that TLB has led to a persistently low yield, poor quality corms, and decreased commercialization (Mbong et al., 2013; Onyeka, 2014).

Cooler temperatures, unrestricted moisture from rain or dew, and a constant daytime wet season are also favorable for the sporangia to produce zoospores (Mbong et al., 2013) while rain splash and wind blow favored its distribution within and between plants (Mbong et al., 2013; Abdulai et al., 2020). It was observed in the study area that farmers can use the same taro farmland for years, and rotation is less practiced as most of the farmers grow taro mainly in marshy lands. This agronomic practice implies that the pathogen can be conserved in the soil from season to season. Previous research revealed that a small percentage of the discharged zoospores in the soil develops a thick wall to become chlamydospores, which can live in the soil for up to three months and may allow the pathogen to survive between harvests (Quitugua and Trujillo, 1998). The pathogen can also survive through vegetative mycelium in infected corms (Gollifer et al., 1980; Mbong et al., 2013).

Conclusions

This survey revealed a need for urgent action to preserve taro genetic resources in Benin. The TLB epidemic in 2009 led to a decline in taro production. Farmers' perception of the value of the taro corms revealed demand for varieties with good organoleptic qualities, high yield, and short maturity. In addition, there is no need to enhance awareness about TLB and control methods and a need for the introduction of TLB-resistant varieties to sustain production. New culinary practices and processing methods may also be needed to produce new taro products by reducing the anti-nutritional properties responsible for the high acridity of the corms in certain varieties and enhancing the value of taro corms. A diversity study of taro cultivars in the Southern part, Central and Northern parts of the country will be of great relevance.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Supplementary

Supplementary file 1. Markets surveyed in taro growing regions of southern Benin Republic.

Department/Region	Commune	Market name	Latitude	Longitude	Altitude (masl)
Couffo	Aplahoue	Azove	6.9446858	1.6973573	188.7
Couffo	Djakotomey	Djakotomey	6.9080996	1.7138861	141.9
Oueme	Dangbo	Dangbo	6.5859295	2.5506279	47.4
Oueme	Dangbo	Malome	6.5868234	2.5387617	11.6

Source: Field survey conducted in southern region of Benin Republic in July-November 2021 and January 2022.

Supplementary file 2. Questionnaire used for the survey "ethnobotany and perceptions on the value of taro (*Colocasia esculenta*) among farmers in Benin Republic"

Questionnaire Identification Number: ……..

PART A: INTERVIEW BACKGROUND (Adapted from Baseline Survey on Banana Bunchy Top Disease (BBTD) Situation, Kumar, 2014**)**

1. Date of interview: Day: ……. Month: ……. Year: 20……

Country	State/ Region	LGA/ District	Village/ Community	Rainfall	Humidity	GPS readings of homestead			
						Waypoint ID	Latitude	Longitude	Altitude

2. Locational Details

3. Respondent's name: ……... 4. Sex: M or F (**Circle**); 5. Age: ……. (**In years**)
6. Any telephone for contact: ……
7. Number of persons living in the household……
8. Major source of income……
9. Who makes decisions regarding the following?

Reason for making decision	Who makes decision? *(Code A)*
Crops grown	
Type of taro variety to plant	
Farm operation	
Amount of produce to be consumed	
Amount of produce to be sold	
Food security coping mechanism to use in case of food shortage	

Code A: 1=Head of household; 2=Spouse; 3=Both head of household and spouse; 4=Son/daughter; 5=Others (Specify: ……)

PART B: ETHNOBOTANY AND USES OF TARO (Adapted from IPGRI, 1999)

I. Historical and cultural background

1. What is the local name for this variety? ……
2. What is the meaning of the name? ……..
3. What language and ethnic group is the name from? ……
4. Is there any folklore associated with this taro variety? If so, describe it briefly……..
5. What are the uses of the plant? **..... (1=Food; 2=Medicine; 3=Animal feed; 4=Forage; 5=Ornamental; 6=Ceremonial; 99= other (specify…….))**
6. What are the special uses of this plant? ..... (**1=Children; 2=Older people; 3=Feasts; 4=Religious**

purpose; 5=Chiefs; 99= other (specify……))

7. What parts of the plant are used? **…… (1= Petiole; 2= Leaf; 3= Corm; 4= Cormel; 5= Stolon; 6= Flower/inflorescence; 7= Root; 8= Tuber; 9= Sap/resin; 99=Other (specify……..…..……))**
8. What is the history of this plant use? …… (**1= ancestral; 2= introduced (but in unknown distant past); 3= introduced (time of introduction known)**)

II. Culinary details

9. How frequent is this variety used for cooking? (**1=daily; 2=weekly; 3=occasionally; 99=others (specify……)**)
10. How many methods of processing is/are available... (**1=fermentation; 2=puddings; 3=chips; 99=others (specify……)**)
11. What is the main cooking method? … (**1=Boiling; 2=Baking; 3=Roasting; 4=Local specialties; 99=others (specify…….)**)
12. How long does it take to cook? ……
13. How palatable is the cooked corm? …… **(1=Poor; 2=Acceptable; 3=Good)**
14. What is the consistency of the cooked corms? …… (**1=Sticky; 2=Firm; 3=Soft; 4=Mealy; 99= other (specify……))**
15. Does the cooked corm have an aroma? ……(**0=Absent (Non-aromatic); 1=Present (Aromatic))**
16. How palatable is the cooked leaf? …… **(1=Poor; 2=Acceptable; 3=Good)**
17. How palatable is the cooked petiole? …… **(1=Poor; 2=Acceptable; 3=Good)**
18. How does the cooked inflorescence taste? …… **(1=Poor; 2=Acceptable; 3=Good)**

III. Taro value

19. Is the plant popular among farmers and the people? …..... **0=No; 1=Yes**
20. Is there a premium value for the corm? …… **0=No; 1=Yes**
21. Is there a premium value for the leaf? …… **0=No; 1=Yes**

IV. Taro ecology

22. What is the suitable growing condition? …… **(1=Wet land (flooded); 2=Wet land (raised beds); 3=Upland; 4=Slopes; 5=Natural swamp; 6=Atoll (pits); 99= other (specify…...)**
23. What is the planting date? ……
24. What cropping system is adopted? …… **(1=Monoculture; 2=Intercropped)**
25. What is the harvesting date? ……
26. What time of the year is the plant available? …… **(1=Available only in season/at particular period; 2=Available throughout the year; 99= other (specify…….)**
27. What are the associated floras with the plant? ……

PART C: TARO PRODUCTION AND CONSTRAINTS (Adapted from Baseline Survey on Banana Bunchy Top Disease (BBTD) Situation, Kumar, 2014**)**

1. How long have you been growing taro? …….. (**In years**)
2. Over the past five years, what is your taro production trend? …. (**1=Decreasing; 2= about the same; 3=Increasing**)
3. What are the five major production constraints? Rank them in order of importance.

(**Starting by 1=the most important**)

Major constraints	Rank

4. What pests and diseases are present and when do you encounter them? (**Use codes below**)

Pests and diseases encountered	**When? (code A)**	**Pests and diseases control strategies if any**

Code A: 1. Before corm development; 2: After corm development

5. Will you be interested to destroy all the diseased taros and replant with new plants? 1=Yes; 2=No and Reason……
6. What is the main source of your planting materials? … (**1=Own corms/cormels; 2=Purchased corms/cormels; 3= other, specify**: ……..……)
7. If purchased, from where? …… (**1=Inside this village; 2=Outside the village)**

8. Did you get any problem of pest and diseases in your taro production last season? …1=Yes; 2=No
9. If answer is 'yes' for question 8, did you use chemicals or other methods to control it? .....
10. Were you satisfied with the control method? ..... 1=Yes; 2=No
11. If answer is 'no' for question 10, state reason.....
12. Are you aware of Taro Leaf Blight (TLB)? 1=Yes; 2=No
13. Are your fields affected by TLB? …… YES=1 NO=2; if yes from when (approximate date) and how much area was lost? .....
14. Are you aware of any TLB control technologies? How did you get this information? …..
15. If you are aware of any TLB control technology but have not adopted any, what is the most important reason for non-use? (Circle one only)

1. Gathering more information about the technology
2. Technology not available
3. Too risky to adopt
4. Traditional control practice is better.
5. Lack of cash
6. Lack of sufficient labor
7. Others (e.g. cultural factors) ……

20. In case of non-adoption of TLB control technology, do you expect to adopt it later? ..... YES=1 NO=2
21. If NO from 20 above, do you plan never to adopt it? ..... YES=1 NO=2
22. If YES from 21 above, give the reason for thinking never to adopt it ……

* Where only tannia (*Xanthosoma sp*.) is found

1. How long have you been growing tannia (Xanthosoma sp.)? ..... (**In years**)
2. Do you prefer tannia to taro? .....
3. If #2 is yes/No, Why?.....
4. Why do you have only tannia on your field? ..... (Disease incidence of taro or what)
5. If #4 above is due to disease, then what disease wiped off the taro plants?

PART D: FARM STRESSES AND RISK LIKELIHOOD (Adapted from Baseline Survey on Banana Bunchy Top Disease (BBTD) Situation, Kumar, 2014**)**

1. What are the major production constraints? Rank them in order of importance.
(**Starting by 1=the most important**)

Major constraints	**Rank**

2. Which pests and diseases are present and when do you encounter those (**Use codes below**)

Pests and diseases encountered	**When?**	**Pests and diseases control strategies if any**

3. Which of the following methods do you use to control pests and diseases in your taro farm when you notice them?

Methods	Yes	No	Frequency of Usage			
			Not at all	Rarely	Occasionally	Regularly
Cultural						
Biological						
Chemical						
Indigenous						

4. What is the roughly estimated quantity of the taro corms you got from your farms in the past 4 years?

Farm size (ha)	Year 2017	Year 2018	Year 2019	Year 2020