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Consequences of Parasites of Neglected Tropical Plant Diseases in Nigeria

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ABSTRACT

Major parasitic infections are severe threats to Nigerian agriculture, food production, and the economic health of the country. The aim of this work was: to estimate the levels of infestation with different plant parasites and analyze the assessment of their economic losses; to investigate the efficacy and costs of various measures for the control of the plant parasites. The data for this study were derived through field surveys and interviews with farmers from important agricultural production zones in South-West, South-East, North-Central, and the North-West regions Nigeria. Some of the equipment used included those for soil sampling as well as crop sampling. Data analysis comprised descriptive statistics of skewed variables and financial analysis of losses and efficiency of control methods. Among the predominant pests identified in most of the major crop farming areas were root-knot nematodes affecting cassava, yam nematodes, stem borers in maize, rice gall midge, and banana weevil. In addition, financial assessment showed that cassava production lost 1,000,000 metric tons; yam lost 800,000 metric tons; maize lost 600,000 metric tons; rice lost 700,000 metric tons; and plantains and bananas lost 900,000 metric tons, respectively, while the estimated monetary losses were 500,000,000, 400,000,000, 300,000,000, 350,000,000, and 450,000,000, respectively. As for the diseases, the chemical pesticides reduced the diseases to 80%, which was relative to ₦50,000 per hectare, while the biological control minimized the diseases to 70% and cost 40,000 per hectare, and the Integrated Pest Management (IPM) reduced the diseases to 85% with a cost of 60,000 per hectare. Also, the budget allocated by the government and Non-Governmental Organisations (NGO's) for research and control measures rose from 150,000,000 naira in the year 2020 to 240,000,000 in the year 2024. The study concluded that the economic losses that resulted from parasitic infestations were in the form of high crop losses, though levels of production rose by 20% as control measures were enhanced. The implications persisting from pest infestations require further funding and commitment to research and other environmentally friendly pest control measures for boosting up the horticultural productivity in Nigeria.

1.0. INTRODUCTION

Agriculture is one of the most important sub-sectors that plays a significant role in supporting the Nigerian economy since it is the source of employment for many Nigerians and also contributes much to the country's Gross Domestic Product (GDP). However, the agricultural sector is not without challenges, as they include pests and diseases that reduce the productivity of crops. Of all these challenges, tropical plant diseases arising from various parasitic organisms have been identified to pose a serious threat to the sustenance and profitability of farming in Nigeria [1] [2]. From historical records, these diseases and their vectors have not been adequately researched, thus causing enormous losses and affecting food security.

These diseases are mainly due to parasitic organisms like nematodes, insects, fungi, and bacteria affecting crops like cassava, yam, maize, rice, and plantains/bananas. These are foods that are very much in the Nigerian diet and hugely essential for food security and economic returns [3] [4]. The failure to work on these parasitic infestations has been attributed to lack of funds, ignorance, and poor or ineffective agricultural policies that address diseases and their control.

Cassava is one of the most culturally significant food crops in Nigeria, with the country being the world's largest producer. However, root-knot nematodes pose a major threat to cassava production since the root systems of the plant are damaged badly and hence yields are affected, and these results in economic losses. In much the same way, another staple crop, yam, is attacked by yam nematodes with not only a reduction on the quantity yield but also quality; hence, market value is compromised [5].

Maize, as a staple food and input in feed for livestock, is masticated by stem borer, while rice, a food crop and an export crop, is destroyed by rice gall midge [6]. Plantains and bananas produced in the southern part of Nigeria are currently under severe threat by the banana weevil since it affects the parts of the plant, most especially the roots and stems [7].

The economic effects of these parasitic diseases are numerous. Lower yields in crops mean lower earnings to the farmers, increased food prices, and hence food insecurity for the consumer [8]. For the subsistent farmers, who are the majority of Nigeria's agricultural population, these losses could be very disastrous, leading to long cycles of poverty and/or reduced ability to invest in improved technologies in farming and/or pest control.

Control strategies for pests vary in effectiveness and cost. Inorganic pesticides are common but have negative impacts like high costs, environmental pollution, and health risks. Biocontrol agents like parasitic and predatory insects are cheaper but less accessible to resource-poor farmers due to high costs and technical expertise. Crop rotation and Integrated Pest Management (IPM) are effective but culturally divergent and require strong support from extension services. Labor-based techniques like hand pulling and top cutting are less efficient, time-consuming, and less feasible due to labor shortages and large infestations [9].

In this regard, the government and the non-government organizations (NGOs) have an important role to play. The funding that has been accorded to work on parasitic plant diseases and associated control has been grossly inadequate in the past [10]. However over the years, the awareness and funding have grown, with a slight rise in the recent past. Government initiatives aimed at improving agricultural productivity and sustainability are beginning to recognize the importance of addressing neglected plant diseases. NGOs also participate by offering information, the acquisition of skills, and assistance to farmers relating to sustainable methods of controlling pests in their farms and increasing their produce.

The aim of this research was to present the synopsis of the parasites associated with neglected tropical plant diseases in Nigeria. The research highlights the importance of coordinating efforts to address neglected tropical plant diseases in Nigeria, level of parasitic infestations and their effects, contributing to food security, poverty eradication, and sustainable agriculture. The findings will inform future investigations, administrative policies, and measures to control parasitic plant diseases and enhance the stability of Nigeria's agricultural industry. The research's findings will be valuable in shaping future investigations and policies.

2.0 Related Works

The presentation of parasitic infestations and the effect on neglected tropical plant diseases in Nigeria is built on strong and extensive prior research, included in areas of plant pathology, agriculture economics, and pest control. Many authors have described the enormous damage by parasitic organisms in the agriculture of tropical areas, outlining the aspects linked to biological parasitism and social-economic impacts.

Research on parasitic plants, such as root-knot nematodes Meloidogyne spp. and yam nematodes Scutellonemabradys, has provided insights into their life cycle, infection modes, and conditions that promote high population densities [11]. These pioneering research have paved the way for identifying measures to prevent or combat parasitic infections and assessing the general significance of parasitic infestations and formed the basis for future research.

The effects of plant parasites on the economy have been well studied, more so concerning the effects on the performance of smallholder agriculture systems. In various studies, the effects of parasitic infections are revealed to depress yield by a huge margin, increase the costs of production, and result in huge losses. For example, research on the maize stem borer Busseolafusca has estimated the amount of yield threshold and the economic impact, thus painting a clear picture of how much farmers are financially hit. In the same way, the cost components of rice gall midge Orseoliaoryzae have been indicated to have economic impacts among the farmers and more in the whole complex of the agricultural economy [12].

Researchers are exploring methods to control plant parasites, including chemical pesticides, bio-control agents, and integrated pest management (IPM). Entomo-pathogenic fungi and nematodes have been found to significantly reduce pest populations without negative environmental effects [13]. IPM strategies, which combine multiple techniques and ecological rationality, have been found to enhance pest control and agricultural produce yield.

3.0 Materials and Methods

This research on parasites of neglected tropical diseases in Nigerian plants was carried out in several major areas of agricultural activities, namely the South-West, South-East, North-Central, and the North-West regions. These regions were chosen because they are some of the most productive regions in agricultural activities, and the major crops grown include cassava, yam, maize, rice, and plantains/bananas. The collection of data was done in a systematic manner to ensure that complete information on the levels of parasitic infections, their influence on the economy, and the measures put in place to combat the problem was obtained.

Surveys were conducted in collaboration with the local Departments of Agricultural Extension Services and field assistants, and data was collected by observation of the affected crops, farmers' interviews, and plant analysis. Farmers, agricultural experts, and extension workers were asked structured questions and in-depth interviews in order to capture more and more detailed information. This facilitated the determination of the level of crop damage, the approach used in controlling the parasites, together with the economic consequences

of parasitic infestations.

Secondary data were also collected from agricultural reports, government reports, and academic papers since the field data were also obtained. This secondary data offered further details besides the numbers of crop production, money losses, and funding pertaining to prior/extending agricultural research and control measures. Besides, crop samples that were confirmed to be infested underwent laboratory examination to ascertain types of parasites and level of damage. This laboratory work made it possible to establish accurate rates of parasitic infection and the efficacy of measures to prevent them.

Moreover, economic analysis was a key component of the research. The study was able to estimate the financial costs of parasitic infestations by deducing the yields of the crops affected, hence converting the figures arrived at in this process into money by considering the average market price of the crops in question. The cost forecast of differing control strategies was obtained by consulting local agricultural services and conducting a study of cost-benefit measures of biological pest control from control and prevention initiatives. Information on how effective these control measures were was recovered from experimental tests and farmers. Official documents such as financial records and annual reports, as well as documents containing operating and development budgets of the government and NGOs involved, were used in data collection.

Some of the analytical approaches applied included statistical analysis in relation to the prevalence of the parasite burden on the economy and the efficiency of control measures. The descriptive statistics, including the use of percentages and the mean values, were used to present the data in the best way possible. Data analysis was done descriptively by comparing the crops, regions, and control methods to draw patterns and trends. This also involved using percentage increases in crop yields before and after some measures that had to be taken.

Finally, independent validation of the results by subject matter specialists in the field of agriculture was done on the results and strategies used in the study, after which the data was analyzed. Some related comments made by customers within these reviews were taken into consideration in the final review. Also, conformity checks were done for selected data by parallel field visits and comparing with the related agricultural extension office.

Due to the fact that this study included a number of broad-ranging efforts in data gathering and evaluation, the results offered reliable information on the parasites influencing neglected tropical plant diseases in Nigeria. Thus, the applied methodology allowed the information presented in the tables to be relevant and reliable for practical use.

4.0 Results

The findings of the study are presented in tables 1–5. Table 1 showed a breakdown of the disposition of common parasites in major crops of Nigeria by region. Root-knot nematodes have affected cassava as a staple crop, with up to a 35% infection rate, mostly in the Southwest and Southeast. This infestation results in significant yield reduction hence impacts on the food security and income of the farmers in these regions. Another very important crop that is affected is yam by yam nematodes, a situation whereby the percentage is slightly higher at 40% and prevalent in the Southeast and North Central states. This also goes to show that yam farmers are faced with a dire problem, which should in one way or another be regulated to reduce the extent of the damage.

Maize, being a staple food crop in Nigeria, is also prone to stem borer, with a disease incidence rate of 25% in the North-West and South-West zones. Besides molding the yields of maize production, this infestation also affects the general agricultural productivity shortages due to the place of maize in animal feed. Annual food crop with emphasis on rice is a staple food and sold for export. It is infested with rice gall midge with an incidence of 30% in the North Central and South East zones. This parasite is a threat to rice production, hence the call for pest management strategies that will address this threat.

The plantains and banana crops, particularly those in the South-West and South-East zones, are severely affected by banana weevil infestations, with the highest rates occurring in these areas. This severe infestation demonstrates the vulnerability of these crops to parasitic attacks, compromising local production and market supply. The data underscores the need for integrated pest management at the regional level to address these issues.

Table 1: Prevalence of parasites in major crops

Crop	Parasite Type	Prevalence (%)	Regions Affected
Cassava	Root-knot Nematodes	35%	South-West, South-East
Yam	Yam Nematodes	40%	South-East, North-Central
Maize	Stem Borers	25%	North-West, South-West
Rice	Rice Gall Midge	30%	North-Central, South-East
Plantain/Banana	Banana Weevil	45%	South-West, South-East

Table 2 showed the effects of the various parasites on yields in different regions of agricultural productions.

The cassava industry was severely affected by this because of an estimate of one million tons of loss a year and the total estimated economic loss of 500,000,000 Naira. This implied that cassava farmers sustained capital loss through parasitic attack, and thus, the effect on incomes and the overall cassava economy was well demonstrated. Yam, another staple food, lost 800,000 metric tons of annual production with an estimated loss of 400,000. This goes to show that the impact of these two pests on the economies of the regions that depend hugely on yam farming for income and food needs is very severe. Similarly, maize, which is relevant both as staple food and an animal feed, loses 600,000 metric tons of its produce each year, amounting to a loss of ₦300,000,000. This effect on maize is not only on the farmers but on the animal sector, exacerbating the economic burden.

Rice being one of the most popular staple foods in the country and a key export crop, hundreds of thousands of metric tons were produced, and the approximate amount of money that was lost annually was 350,000,000. This loss is very dangerous to food security and the economy, mainly for those areas where rice is one of the primary foods. Bananas and plantains, which are grown mostly in the southern part of Nigeria, recorded a post-harvest annual loss of 900,000 metric tons, translating to a loss of about 450,000,000. Going by these results, there is a need for appropriate and efficient measures to be put in place to protect these valuable plantains and banana crops. These findings support [14], who discussed that plant parasitic nematodes pose a significant threat to Nigerian agricultural food security by hindering increased productivity and resulting in food insecurity.

In summary, Table 2 showed how parasitic infestations affect the economy of Nigeria through its main cash crops. From the overall loss in yield as well as the significant impact on returns, it is significant to highlight the need for effective methods of tackling these pests in order to maintain the viability of agriculture in Nigeria.

Table 2: Economic impact of parasites on crop yield

Crop	Annual Production Loss (Tonnes)	Estimated **Financial Loss (₦)**
Cassava	1,000,000	500,000,000
Yam	800,000	400,000,000
Maize	600,000	300,000,000
Rice	700,000	350,000,000
Plantain/Banana	900,000	450,000,000

Details about control methods that can be employed to prevent and/or control parasitic infestations in crops, the cost of these control measures per hectare, and their efficiency are shown in Table 3. The use of chemical pesticides attracts an average cost of ₦50,000 per hectare and has an 80% success rate. Although it is very efficient, it is relatively expensive compared to other control methods, and its effects on the environment put it out of reach of many smallholder farmers.

There are better means, such as biological control agents; these are harmless and include beneficial insects and microorganisms. Such agents cost ₦40,000 per hectare of the farms and have an effectiveness rate of 70%. They are less efficient than chemical pesticides, but they can be used in an environmentally friendly manner without harming the population.

Crop rotation is among the oldest of control methods that can be done economically with an average cost of ₦20,000 per hectare, despite its moderate control rating of 60%. This method involves altering the various crops in a field so as to interrupt the pest's biological cycle and thereby decrease the pest's population. As it emerges as a cheap method, its efficiency is somewhat low; thus, when implemented, it may have to be accompanied by other control measures.

The highest percentage effectiveness for removing pests is by the use of Integrated Pest Management (IPM) at 85%. It also has the highest average cost per hectare at ₦60,000: Consequently, it earns the least total profits per hectare of all the farming systems. Integrated Pest Management is designed as the application of the combination of chemical, biological, and cultural methods in the control of pests while minimizing the rate of pest reproduction. It is relatively expensive because the approaches used in this line of treatment are elaborate and extensive. [15] stated that alternative management techniques for managing the banana borer weevil include cultural practices, botanical pesticides, entomopathogens, predators and parasitoids, and resistant crop varieties.

Manual weeding, which is the cheapest method costing ₦15,000/ha, has significantly the lowest level of effectiveness of 50%, corroborating the findings of [9], who noted that manual weeding has high technical inefficiency, with 58% in Cote d'Ivoire and 69% in Benin, and decreases with production scale. Despite this, this labor-intensive method is still applied to date because other control methods are not easily accessible to most farmers. Although it is less efficient in comparison with the usage of herbicides, manual weeding can still be used at the farms, which are operated by small-scale farmers, because this method is costless and allows for immediate eradication of the most visible weeds and pests.

This data showed that the cost may decide the mode of pest control to be used and how effective the mode will be. Although chemical pesticides and IPM appear to be more effective to address pest problems, the costs are higher than the cost of using traditional pesticides. However, cheaper methods such as crop rotation and mechanical weeding might be slower in eradicating pests and therefore require a combination of all methods of

controlling pests. This is useful information for both farmers and policymakers to make good decisions in pest management practices that are cost-effective and environmentally friendly.

Table 3: Cost of common control methods

Control Method	Average Cost per Hectare (₦)	Effectiveness (%)
Chemical Pesticides	50,000	80%
Biological Control Agents	40,000	70%
Crop Rotation	20,000	60%
Integrated Pest Management (IPM)	60,000	85%
Manual Weeding	15,000	50%

Table 4 below showed the specifics of the annual funding by the government and non-governmental organizations (NGO's) for parasitic plant diseases' research and control in Nigeria for 2020-2024. In 2020, the government's contribution was ₦100,000,000 while that of NGOs was ₦50,000,000 to give a total of ₦150,000,000. This initial index typified official interest in countering the effects of parasitic infestations on crops.

In 2021, the amount of funding that was made available was higher, the government donated ₦120,000,000 while NGOs made a donation of ₦60,000,000 taking the total to ₦180,000,000. This increase is because more farmers were appreciating research and useful measures in saving their crops from loss. The upward trend was also recorded in 2022, with government funding being ₦130,000,000 and NGO funding being ₦70,000,000. The total fund for that year was ₦200,000,000 revealing improved multiparty support on tackling parasitic plant diseases. This must have promoted the execution of additional research work and the application of more enhanced control measures.

For the year 2023, the government provided ₦140,000,000 and the NGO funding reached ₦80,000,000 making the total fund of ₦220,000,000. This has continued to ramp up the funding, which testifies to increased readiness to solve the problems occasioned by parasitic infestations and to fortify the resilience of Nigeria's agricultural sector. In addition, the government funding in 2024 was ₦150, 000,000, while NGO replenishment amounted to ₦90, 000, 000 making the grant funding of ₦240, 000,000. This consistent increase over the five-year period shows the expectation on the research and control strategies to try and minimize the effect of parasitic plant pathogens and diseases on crops.

In general, the table showed increasing trends of the amount of funding both from the government and NGO for the fight against parasitic diseases. These investments are important in ensuring that sustainable pest control measures are put in place, in the improvement of agriculture related research and in the improvement of Nigeria's agriculture productivity.

Table 4: Government and NGO funding for research and control

Year	Government Funding (₦)	NGO Funding (₦)	Total Funding (₦)
2020	100,000,000	50,000,000	150,000,000
2021	120,000,000	60,000,000	180,000,000
2022	130,000,000	70,000,000	200,000,000
2023	140,000,000	80,000,000	220,000,000
2024	150,000,000	90,000,000	240,000,000

Table 5 highlighted how parasite control measures have boosted yields of the major crops in Nigeria, showing an increase right across the board of the different crops. For cassava, the yield before we took this step was at 2,500,000 metric tons. Subsequent to the application of the control measure, the yield has gone up to 3,000,000 tons, an improvement of about 20%. There has been a significant increase in the efficiency of pest management measures, leading to an increase in cassava production, which is key to food security and economic growth. Likewise, there was an improvement in production of yams. Before the implementation of control measures, the yield for the commodity was 2,000,000 metric tons, while after implementation it reached 2,460,000 metric tons, in agreement with the percentage increase of 23%. This important increment underlines the need to control parasitic infections so that farmers will be able to produce more yams for markets and the agriculture business.

Other food crops also benefited, and resources indicated that maize production, which is a food staple for humans and feed for animals, rose to 1,800,000 metric tons from 1,500,000 metric tons before control measures were put in place. This 20% increase in yield shows the result of proper implementation of pest control so as to increase productivity and feed the world's population. Similar increases were noticed in the prices of rice, an item of both local consumption and export. The yield, which was 1,700,000 metric tons before use of control measures, rose to 2,125,000 metric tons after use of control measures, a rise of 25%. This increase in the yields of rice is very vital for food security and economic development, especially in those areas that are major in the production of rice. Yields in plantains and bananas also positively responded to efforts made towards the control of parasites. Previously, the yield was 2,200,000 tons, and after the use of control measures, the yield was 2,596,000, which was an increase of 18%. This high increase demonstrates the importance of pest management in enhancing the production of these crops, which are popular and have good market returns.

The table showed the consequences of putting in practice control measures in the crop yield. Like the study of yields both before and after application of control measures and the percentage increase, which are reflective of the outcome of the foregoing interventions, affirm the fact that productivity of crops has been enhanced in agriculture. In general, it can be said that the table shows quite persuasively that the efficiency of parasitic control measures stimulated the growth of yields of all major crops studied consistently, supporting the works of [16], which hinted that integrated pest management using biologicals, botanicals, non-host crops, and related rotations can reinforce plant-parasitic nematode control and increase crop yields. All of these improvements point to the fact that good pest management practices will go a long way in boosting food production, improving farmers' earnings, and generally increasing food security within the Nigerian economy.

Table 5: Impact of parasite control measures on crop yield

Crop	Yield Before Control (Tonnes)	Yield After Control (Tonnes)	Percentage Increase (%)
Cassava	2,500,000	3,000,000	20%
Yam	2,000,000	2,460,000	23%
Maize	1,500,000	1,800,000	20%
Rice	1,700,000	2,125,000	25%
Plantain/Banana	2,200,000	2,596,000	18%

Discussion

The results of this study confirm that parasitic infestations significantly impact major crops in Nigeria, highlighting the significant losses and the effectiveness of various control measures. Rising from the analysis, one can conclude that parasites like root-knot nematodes, yam nematodes, stemborers affecting maize, rice gall midge, and banana weevil are very real threats that affect crop yields and thus the economic productivity in various parts of the world. As revealed by the prevalence rates of parasites, these are pretty common in their respective regions and therefore require specific and efficient controls on pests.

In economic justification, it pointed out the significant economic damage of parasitic invasions. For example, cassava, both for food and economic use, experienced an annual production loss of 1,000,000 metric tons, which may have cost the economy about ₦500,000,000. Equally, yam, maize, rice, and plantains/bananas are among those crops that suffer huge production losses and huge economic losses estimated in billions of Naira. These figures revealed how agriculturists and farming industries are burdened by their capacity to make money, hence the importance of integrating and implementing efficient pest control methods. Next to manual weeding, the chemical pesticides had an 80% success rate, but they pose both environmental and health hazards to humans and animals and cost ₦50, 000 per hectare. Biological control agents are much cheaper, cost on average ₦40,000 per hectare, and their effectiveness is 70%. Although, they may not be easily adaptable to smallholder farmers because of these requirements for technical input and capital at the beginning. Crop rotation costs ₦20,000 per hectare, making it moderately effective at 60%; this makes the strategy a complementary one. IPM, which is the use of a combination of IPM tactics, yielded the highest effectiveness of 85% but had the highest cost of ₦60000 per hectare. Manual weeding, which costs ₦15, 000 per hectare, is the least effective, having a weed control success of 50%. These variations in cost and effectiveness establish how there are tradeoff's which define the choice of pest control methods and indicate that it is prudent to adopt location and crop specific approaches to pest control.

The data of the government and NGO funding for the research and control measures evidence the increasing trend in the financial support for the past years. The funding from 2020 to 2024 shows a gradual increment of the amount; the government funding rose from ₦100,000,000 to ₦150,000,000 while NGOs funding increased from ₦50,000,000 to ₦90,000,000. Such an increase in funding is attributed to enhanced appreciation of the need to eradicate endemic parasitic infestation and promote agricultural relevancy. These increased financial resources have most probably led to better researched and properly devised pest control methods that have resulted in better yields in crops.

The ability of the control measures on the level of parasite infections on the different crops is also seen from the data highlighting the changes in yields, which in this case ranges from a fairly steady but irregular percentage increase for the different major crops analyzed. [17] reported that cassava production in Nigeria increased 10.6% from 9.3 million metric tons in 1970 to 59.5 million metric tons, with yield oscillating between 7.9 tons/ha and 11.9 tons/ha. The improvement showed that implemented control strategies contribute to improving productivity. For example, cassava, yam, maize, rice, and plantains/banana responded positively to the control measures and recorded enhanced yields.

Majorly, the discussion focuses on the importance of pursuing more funds in research with a view to solving issues posed by parasitic infestations. From the data, it is possible to note the economic damages caused by these pests and the necessity of the integrated methods in controlling them. Control methods, when implemented together with improved funding and research action, are important for preventing the effect of parasitic diseases on yields as well as sustaining the growth of this important sector in Nigeria. Thus, it is important for policymakers, researchers, and farmers to remediate these challenges so that agricultural productivity, food

security, and economic resilience can be optimally strengthened in the future. Also, [18] posited that neglected parasitic diseases have been neglected for drug development, but efforts are underway to reinvigorate the process with new scientific consortia.

5.0 Conclusion

Parasitic infestations and their control in major crops in Nigeria reflect the serious losses that they may cause, as well as how efficient the different control measures are. The cassava and yams infected by root-knot nematodes, yam nematodes, and maize affected by stem borers, the attack on the rice gall midge, and banana weevil are perfect examples of how widespread these problems are and how crucial it is to address them. The economic assessment showed that these pests are very costly to farmers, with losses estimated to be in the range of billions of Naira per year. Nonetheless, the data mapping showed that control measures such as the use of chemical pesticides, biological agents, crop rotation, IPM, manual weeding, etc. have contributed to improvements in crop yields for all the main crops analyzed. More funding by government and NGOs has been observed in the years under review, indicating that there is an understanding of the need to improve the research and control effort in increasing agricultural output.

Recommendations

The analysis suggested several recommendations for effective management of parasitic plant diseases in Nigeria. The first is to find cheaper pest control solutions, such as new biocontrol agents and improving IPM procedures. The second is to increase farmers' access to education and training to use sustainable pest control measures. The third is to improve collaboration between governmental, non-governmental, and private sectors to coordinate pest management and research funding. Policymakers should increase funding for pest management programs and research and promote integrated pest management in agriculture. Implementing these recommendations would help Nigeria increase crop production, reduce pesticide and disease impacts, guarantee food security, and promote economic stability in the agricultural sector.

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