



THE POTENTIAL PRODUCTION, HEALTH AND ECONOMIC BENEFITS OF INTERCROPPING RUBBER (*Havea brasiliensis*) TREE WITH TURMERIC: A REVIEW

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ABSTRACT

Turmeric (Curcuma longa) is among the herbaceous medicinal crops, it is also known as “the golden spice of life”. Turmeric is a shade-loving plant which can be intercropped with rubber without any harm to either plants, turmeric rather even thrive excellently when the rubber trees have attained canopy closure. This paper reviews the benefits of intercropping turmeric with rubber, awareness of turmeric as medicinal plant, marketing channels, prospects and challenges. This review relied on information from journals, newspaper reviews and the internet. Turmeric contains bioactive compounds with powerful medicinal uses. It is used in the textile industry as dye and in the food industry to impart colour to food and also in the pharmaceutical industries as essential component of drug production. In Nigeria turmeric farming has a lot of potential for local industries and export, but it rather receives little attention from farmers due to lack of knowledge of its potentials.

Key words: Turmeric, Intercropping, Rubber, Medicinal usage, Challenges, Prospects.

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INTRODUCTION

Rubber (*Hevea brasiliensis*) attains maturity at about 5-7 years (Esekhade *et al.*, 2014). This puts a lot of pressure on the smallholder farmers as the rubber plantation cannot be tapped for latex and this imposes economic hardship as no income is generated from the rubber plantation, but with the introduction of intercropping, small holder rubber farmers have been able to withstand this long wait for rubber plantation to attain maturity (Esekhade *et al.*, 2003).

Intercropping is the practice of growing two or more crops in close proximity. Adequate planning must be done in terms of the soil, climate, crops etc. The

intercrops should not compete with each other for physical space, nutrient, water or sunlight. When compatible plants are planted together, they encourage biodiversity, whereby variety of insects and soil organism, that would not have been present in a single crop environment will be present (Surkar *et al.*, 2011). There have been different crops that can be intercropped with rubber, such as cassava, pineapple, maize, vegetable, plantain, cocoyam, peppers, melon, medicinal plants (ginger and turmeric) and yam etc (Mesike *et al.*, 2009).

It has been shown that Turmeric has a lot of potential especially as a medicinal plant. It was also very useful during the

Covid-19 era as it was used as tea in combination with other herbs to boost the immune system (Gupta *et al.*, 2020). Turmeric is also a cash crop as it can be exported, and that will help in cushioning the effect of poverty among smallholder farmers as they await the maturation of the rubber plantation.

Despite this numerous advantages a lot of smallholder farmers especially in the Southern part of Nigeria do not plant this golden plant. Studies have shown that, little or no documented usage of turmeric in Nigeria. Farmers and the general populace, have no knowledge of the importance of cultivation and consumption of turmeric as such the cultivation is not taken very seriously (Uchechukwu, 2020). They also are not aware of the medicinal properties of turmeric.

This review therefore focused on the benefit of intercropping turmeric with rubber in order to create awareness of turmeric as medical plant, usage, marketing channels, prospects and challenges, in the use of turmeric as an intercrop in rubber plantations.

Benefit of intercropping turmeric with rubber

Turmeric of economic importance is the cured and dried rhizome or underground stem of a perennial herb, *Curcuma longa* L (family: Zingiberaaceae). Turmeric is used as condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. (Prasath *et al.*, 2022). Turmeric is thought to be indigenous to the Indian subcontinent, though its cultivation spread from India to Southeast Asia, China, North Australia, the West Indies, and South and Central America (Jiang, 2005). In Nigeria, it can be found growing from low altitude, 5m above sea level in the derived Savanna within Longitude 03⁰02'E – 09⁰30'E and latitude 4⁰37'N – 10⁰04'N (Olojede and Nwokocha,

2011). It can be seen grown in small plots around homes (Olojede *et al.*, 2005) and can also be found in the wild (Olife *et al.*, 2013). Farmers are beginning to see the importance of its cultivation, and it's been grown as cash crop especially in Southern part of Kaduna State. Turmeric is a cross-pollinated, triploid species ($2n = 3x = 63$), which can be vegetatively propagated using its underground rhizomes (Sasikumar, 2005).

Studies have shown that the active constituents in turmeric are curcuminoids and essential oil, which is crucial for the quality of both the plant and its processed products (Jiang, 2005; He *et al.*, 1998). The curcuminoids found in turmeric are curcumin, demethoxycurcumin, and bisdemethoxycurcumin 3-5% of raw plant (Verma *et al.*, 2013). Turmeric is also used as colourant of curries, it also has anti-inflammatory (Lukita Atmadja *et al.*, 2002) anti-arthritic, anti-oxidant (Masuda *et al.*, 1999), anti-allergic, anti-bacterial (Chattopadhyay *et al.*, 2004; Fagbemi *et al.*, 2009), anti-cancer (Shao *et al.*, 2002; Duvoix *et al.*, 2005), anti-coagulant, antispasmodic, anti-parasitic, anti-mutagenic (Shukla *et al.*, 2002) and anti-viral (HIV) properties (Ammon and Wahl, 1991). The essential oil also in turmeric are bisabolance sesquiterpenes that include arturmerone, curlone, &-turmerone, -turmerone as well as some other sesquiterpenes like Zingiberene curcumenone, curcumenol; procurcumenol dehydrocurdione, and germacrone -13-al (He *et al.*, 1998); Chattopadhyay *et al.*, 2004). Sesquiterpenes such as ar-turmerone in turmeric have also been reported to have hepatoprotective (Miyakoshi *et al.*, 2004), Mosquitocidal (Rotn, 1998) and apoptosis inducing properties (Ji *et al.*, 2004). Turmeric is also used as a food additive, condiment and medicine.

The benefit of intercropping turmeric with rubber is therefore very much desirable

considering the numerous uses of Turmeric. Also, as a shade loving plant, it can be grown when the rubber tree has attained canopy closure and it will still thrive well. Intercropping has also proved to be very beneficial to farmers (Mesike, 2009).

Cultivation of Turmeric

Turmeric can be grown in diverse tropical conditions from sea level to 1500m above sea level, at a temperature range of 20-35°C with an annual rainfall of 1500mm or more. The crop can be grown under rain fed or irrigated conditions. It grows in all soil type but does well in well-drained sandy or clay loam soils with a pH range of 4.5 - 7.5 with good organic matter status.

Preparation of land: This involves site selection, clearing and making of beds of 3m x 2m preferably to avoid the destruction of young plants during farm operations such as weeding, herbicide and fertilizer application etc. Turmeric can also be planted in ridges or on mounds. Turmeric is propagated by rhizomes. They are planted vegetatively with sets (rhizome) of 10-15g with one or two buds. About 1 ton of sets are needed to plant an hectare of land. Turmeric is planted 10cm deep at a spacing of 50cm and are planted from the onset of rainy season around April and May till first week of June (Nwakor *et al.*, 2014).

Mulching: Mulching of beds is very crucial in turmeric production, and should be done immediately after planting and subsequent mulching done 8 weeks after planting. Mulching helps to conserve moisture, promote germination, suppress weeds regulate soil temperature, supply nutrients to the soil and improve soil physical fertility for maximum yield. Turmeric should be mulched with elephant grass (Straw) at the rate of 12t/ha (Uchechukwu, 2020).

Weeding: Weeding is done within 4-6 weeks after planting depending on the appearance of weed on the farm. Weed affects yield, which could range between 3 and 55% and the critical period of weed interference is between 8 and 12 weeks after planting. (Uchechukwu, 2020).

Fertilizer application: Turmeric field should be fertilized two weeks after planting at the rate of 60kg N, 13kg and 25kg k/ha on a sandy loam utisol. This recommendation translates to application of 200kg/ha NPK 15:15:15 and augmenting with 30kg N/ha (Olojede and Nwokocha, 2011). Alternately, the use of animal dung or dropping is also encouraged to boost soil fertility. Nwokocha *et al.*, (2009) reported that application of 60kg N/ha + 25kg K/ha optimized the yield of turmeric in an utisol.

Harvesting: Turmeric matures 7-9 months after planting. The indication for maturity is when the leaves turn yellow and stand drying up. Harvesting is done by digging out the whole rhizome with spade or hoe. The rhizomes are collected and cleaned. The mother and finger rhizomes are separated after harvesting (Uchechukwu, 2020).

Yield: Nwakor *et al.*, (2014) reported that the yield of turmeric ranges from 20-22 tons per hectare. Though some cultivars under research ranged farms have recorded yields of 35,000 tons per hectare.

Availability and Constraints of Turmeric Cultivation

Due to infrastructural and environmental degradation, most farmers are not so keen in the cultivation of turmeric. The farmers also do not have adequate knowledge and resources to go into turmeric farming (Uchechukwu 2020). Turmeric is an important spice for export yet smallholder farmers still do not have the resources to

grow it in commercial quantity to meet the market demand.

The smallholder farmer lacks the awareness of the potential and uses of turmeric as such, do not go into the commercial production of turmeric, and in most cases it is considered as a woman's crop (Nwakor, 2014).

Economic, Value addition, Market channels of turmeric

Globally, turmeric also known as the "golden spice of life", is produced between 11 - 16 tons annually and India accounts for 78% of this figure followed by China, Myanmar then by Nigeria who produces about 3% of the global annual production (Yusuf, 2020). There are about 76 cultivars of turmeric in the germplasm at the National Root Crops Research Institute, (NRCRI) Umudike. Some are being evaluated on multi-locational trial. They are NCL4, NCL58, NCL 39, NCL 14, NCL 52, NCL 04, NCL 25, NCL 60 and NCL 38 (Amadi *et al.*, 2017).

It is marketed globally in various forms and could be processed into powdered turmeric, turmeric oil, turmeric oleoresin, turmeric candy, turmeric soft drink, turmeric shreds, turmeric prickles etc. They are also used in cosmetic industries in the preparation of soaps, ointments, face cream, toothpaste among others (Nwaekpe *et al.*, 2015, Amadi *et al.*, 2017). They are also used in the textile industries as dyes, and in the pharmaceutical industries as essential component in drug production. An economic study has also shown that turmeric farming is very profitable. This is illustrated in Table 1 below, that shows the profit gotten by farmers in Umudike, Nigeria for the cropping season of 2007 and 2008. A net farm income of N326,918.22k was realized with a N233.90k return per naira and a benefit cost ratio of 3.33.

Challenges of Turmeric Farming in Nigeria

Turmeric production in Nigeria is still very low, especially in southern part. This is due to little or no attention of researchers due to inadequate funding of research activities as a result, its potential is being under exploited (Uchechukwu, 2020). Poor cultivation technology knowledge by farmers is also a great setback to the farming of turmeric especially by smallholder rubber farmers that might want to use it as an intercrop. Little variety has also been formally released for cultivation by Nigerian farmer due to lack of information on the suitability of turmeric cultivars for cultivation in different agro-ecologies of the country.

Turmeric has often been viewed as a woman's crop and of being irrelevant and very limited documentation is available on the economic importance, production, agronomic practices, due to research neglects over the years. The under-utilization of this crop is largely due to lack of awareness. Other challenges that affect farmers are pest and disease attack, non-availability of funds to hire labour, and high cost of planting materials like fertilizers (Olejede and Nwokocha, 2011).

Prospects of turmeric as an intercrop

Nigeria can play a leading role in turmeric production especially if rubber smallholder farmers can also utilize it as an intercrop considering the prevailing favourable soil and climatic conditions in the country. Irrespective of the challenges associated with turmeric research, there are prospects for the development of this product to boost food security in Nigeria. The first step is to harness the opportunity for existing linkages between stakeholders in the supply chain, for example, growers can come together into cooperative growers' groups that source for inputs and market outputs collectively.

Table 1: Labour and inputs costs for production of 1 ha of turmeric at Umudike in 2007 and 2008 cropping season

Items	Quantity of items	Unit cost (₦)	Total cost (₦)
Returns (kg)	2592.75	180.00	466,695.00
<i>Fixed cost:</i>			
Rent on land (m ²)	10,000	1.25	12,500.00
Opportunity cost of fixed inputs@21%			2,625.00
Total fixed cost variable cost			15,125.00
Land preparation (hrs)	12	1,208.34	14,500.00
Planting material (kg)	64	150.00	9,600.00
De-thrashing (md)	16	200.00	3,200.00
Planting (md)	17	200.00	3,400.00
Fertilizer application (md)	9	200.00	1,800.00
Fertilizer requirement (kg)	400	50.00	20,000.00
Primextra (1t)	5.36	1,300.00	6,968.00
Gramazone (1t)	1.10	1,300.00	1,430.00
Herbicide application (md)	4	200.00	800.00
Supplementary hand weeding (2ce)	76	200.00	15,200.00
Harvesting (md)	113	200.00	22,600.00
Other costs			3,520.00
Opportunity cost of variable inputs @ 21%			21,633.78
Total variable costs			124,651.00
Total farm income (TFC+TVC)			139,776.78
Net farm income			326,918.22
Return per naira			233.90
Benefits cost ratio (BCR)			3.33

Akinpelu *et al.*, (2007), **Haulage of planting materials from the store to the field, water for spraying herbicides, haulage of output from the store, cost of 4 tins of milk.

Secondly popularization and promotion of turmeric production, potentials, processing and marketing is essential. It has been observed that many Nigerians lack information on this product.

Thirdly, there is prospect for linkage of turmeric growers and marketers to financial institutions for micro-credit support or loans for these operations for the expansion and effective operation of their farm enterprises (Uchechukwu, 2020).

CONCLUSIONS AND RECOMMENDATIONS

- Turmeric farming in Nigeria has a lot of potential for local industries and export, but it rather receives little attention from farmers due to lack of knowledge of its potentials.
- Owing to its usefulness, it has been processed into powdered turmeric, turmeric oil, turmeric oleoresin, turmeric candy, turmeric soft drink, turmeric shreds, turmeric prickles etc. and

used in cosmetic industries to make soaps, ointments, face cream, toothpaste among others and in the textile industries as dyes; and in the pharmaceutical industries as essential component in drug production.

- The public should be enlightened on the numerous health benefits associated with the consumption of turmeric.
- Turmeric is a cash crop that can be used as an intercrop in rubber and other tree crops plantation to improve the economic status of the smallholder farmers and efforts should also be put in place for the provision of improved varieties for planting especially by the institution that is mandated to carry out that assignment.
- More efforts should be put in place, for the promotion and utilization of turmeric in Nigeria and extension officers should be encouraged to incorporate the economic and food-security potentials of turmeric in their extension services.

REFERENCES

- Akinpelu, A.O., Mbanaso, E.O., Olojede, A.O., Obasi, C. and Amaefula, A. 2007. Economics of turmeric (*Curcuma longa*) production under low altitude agro-ecology: a case study of NRCRI, umudike, Abia state. *NRCRI Annual Report*, 2007. pp.88-92.
- Amadi, P.O.E., Ibe, M.N. and Kalu, C.I. 2017. Turmeric Research in Nigeria Challenges and Prospects for Economic Growth. *Proceeding of the 51st Annual Conference of the Agricultural Society of Nigeria*, Abuja 2017. Pp 19-21.
- Ammon, H.P. and Wahl, M.A. 1991. Pharmacology of *Curcuma Longa*. *Planta Medica*. 57:1-7. doi:10.1055/s-2006-960004.
- Chattopadhyay, J., Biswas, K., Bandyopadhyay, U. and Banerjee, R. K. 2004. Turmeric and Curcumin: Biological actions and medicinal applications. *Current Science*, 87:44-53.
- Duvoix, A., Blasius, R., Delhalle, S., Schnekenburger, M., Morceau, F., Henry, E., Dicato, M. and Diederich, M. 2005. Chemopreventive and therapeutic effects of curcumin. *Cancer Letters*. 223:181-190. doi:10.1016/j.canlet.2004.09.041.
- Esekhade, T.U., Mesike, C.S., Idoko, S.O. and Okore, I.K. 2014. Profitability of Intercropping Food Crops with immature Rubber Plantation in Nigeria. *Proceedings of the 1st National Conference of National Rubber Association of Nigeria (NRAN) on Nigeria Rubber Industry*, held at Benin City 15th – 17th July 2014. Pp. 33-38.
- Esekhade, T.U., Orimoloye J.R., Ugwa, I.K. and Idoko S.O. 2003. Potentials of Multiple Cropping System in young rubber plantations. *Journal of Sustainable Agriculture*. 22(4) 79-94.
- Fagbemi, J.F., Ugoji, E., Adenipekun, T. and Adelowotan, O., 2009. Evaluation of Antimicrobial Properties of Unripe Banana (*Musa Sapientum* L.), Lemon Grass (*Cymbopogon citrates* S.) and Turmeric. (*Curcuma Longa* L.) on *Patuogens*. *African Journal of Biotechnology* 8(7). 1176-1182.
- Gupta, H., Gupta, M., and Bhargava, S. 2020. Potential use of turmeric in COVID-19. *Clinical and Experimental Dermatology*, 45(7):902-903. Published online 2020 October 1. Doi:10.1111/ced.14357
- He X.G., Lin L.Z., Lian L-Z. and Lindenmaier, M. 1998. Lipid Chromatography electrospray mass Spectrometric

- Analysis of Curcuminoids and Sesquiterpenoids in Turmeric (*Curcuma Longa*). *Journal of Chromatography A.*, 818(1):127-132. doi:10.1016/S0021-9673(98)00540-8.
- Ji., M.J., Choi, J.; Lee, J. and Lee, Y. 2004. Induction of apoptosis by Ar-turmerone on various cell lines. *International Journal of Molecular Medicine*. 14:253-256.
- Jiang, H. 2005. Modern Tools to Study Traditional Medicinal Plants, Ginger and Turmeric. A Dissertation Submitted to the Faculty and the Department of Pharmaceutical Science. In Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy. In the Graduate College the University of Arizona 2005. Pp. 262.
- Lukita –Atmadja, W., Ito, Y., Baker, G.L., and McCuskey, R.S. 2002. Effects of Curcuminoids as anti-inflammatory agents on the hepatic microvascular response to endotoxin. *Shock*. 17:399-403. doi:10.1097/00024382-2005000-00010.
- Mesike, C.S., Okoh, R.N. and Orie, O.E.D. 2009. Resource-use efficiency and return to scale in smallholders Rubber farming system in Edo State, Nigeria. *Journal of Human Ecology* 28(3):183-186.
- Miyakoshi, M., Yamaguchi, T., Ikeda, T., Zaman, M.S., Kakihara, H., Takenaka, A. and Igarashi, K. 2004. Hepatoprotective effect of sesquiterpenes in Turmeric. *Biofactors* 21:167-170.
- Musada, T., Hidaka, K., Shimohara, A., Mackawa, T., Takada, Y. and Yamaguchi, H. 1999. Chemical studies on antioxidant mechanism of curcuminoid: Analysis of radical reaction products from Curcumin. *Journal of Agricultural Food Chemistry*. 47:71-77 doi:10.1021/jf9805348.
- Nwaekpe, J., Anyaegbulam, H., Okoye, B.C., Asumugha, G.N. 2015. Promotion of Turmeric for the Food/Pharmaceutical Industry in Nigeria. *American Journal of Experimental Agriculture*, 8(6):335-341. Article no AJEA2015.117. ISSN:22310606. www.sciencedomain.org
- Nwakor, F.N., Asumugha, G.N., Nwokocha, C.C. and Ekedo, T.O. 2014. Guide to Turmeric production, processing and marketing in Nigeria. Extension Guide No.28. Extension Service Programme. National Root Crops Research Institute, Umudike, Nigeria. Pp. 1-11.
- Nwokocha, C.C., Olojede, A.O., Ano, A.O., Chukwu, G.O. and Korieocha, D.S. 2009. NPK Requirement for Turmeric production on an Arenic Hapludult in Southern Nigeria. *Proceedings of the 33rd Annual Conference of the Soil Science Society of Nigeria*. Held at University of Ado-Ekiti 2009. P. 166.
- Olige, I.C., Onwualu, A.P., Uchegbu, K.I. and Jolaoso, M.A. 2013. Status assessment of spice resources in Nigeria. *Journal of Biology, Agriculture and Healthcare* 3(9):12-18.
- Olojede, A.O. and Nwokocha, C.C. 2011. A decade of research on minor root and tuber crops at NRCRI: The contribution toward food sufficiency and economic empowerment in Nigeria, In: Root and Tuber Crops Research for Food Security and Empowerment C.O. Amadi, K.C. Ekwe, G.O. Chukwu, A.O., Olojede, C.N. Egesi (Eds). 2011.387-396.
- Olojede, A.O., P. Iluebbey, and Dixon, A.G.O. 2005. IITA/NRCRI Collaborative germplasm and data collection on minor root and tuber crops in Nigeria. In: *Annual Report 2005* National Root Crops Research Institute, Umudike: 77-8.
- Prasatn, D., Krishnamurthy, K., S., Preveena, R., Jayashree, E., Leela, N.K., Sellaperumal, C. and Aarthi, S. 2022. Turmeric. ICAR-Indian Institute of Spices Research Extension Pamphlet 2022/02.
- Sarhar, Sukanta Pandey, Pradeep Kumar, Ghoshas, P.K. and Mallik, Rajib. 2011. Intercropping in Immature rubber plantation of Dhalai District in Tripura. *International Journal of Plant Science*. 6(1):207-210.

- Sasikumar B. 2005. Genetic resources of Curcuma: diversity, Characterization and utilization. *Plant Genet Resource*, 3:230-251.
- Shao, Z.M., Slen, Z.Z., Liu, C.H., Sartippour, M.R., Go, V.L., Heber, D. and Nguyen, M. 2002. Curcumin exerts multiple suppressive effects on human breast Carcinoma Cells. *International Journal of Cancer*. 98:234-240. doi:10.1002/ijc101 83.
- Shukla, Y., Arora, A. and Taneja, P. 2002. Antimutagenic Potential of Curcumin on Chromosomal aberrations in Wistar rats. *Mutation Research* 515(1-2):197-202.
- Uchechukwu, N.U. .2020. Turmeric Research in Nigeria: Challenges and prospects for food security. *Direct Research Journal of Agriculture and Food Science*, 8:20, ISSN 2354-4147.
- Verma, M.K., Najar, I.A., Tikoo, M.K., Singh, G, Gupta, D.K., Anand, R., Khajuraj, R.K., Sharma, S.C. and John, R.K. 2013. Development of validated UPLC-qToF-MS Method for the determination of curcuminoids and their pharmacokinetic study in mice. *Daru Journal of Pharmaceutical Sciences*. 21(1):11. Doi:10.1186/2008-2231-21-11.
- Yusuf, V.A. .2020. Turmeric: ‘Golden Crop’ Neglected by Nigerian Farmers. Daily Trust, Thursday, June, 25, 2020.