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Tertiary Export Processing Firms in Ghana: The State of the Processing Technology

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ABSTRACT

For several years, the Timber Export Industry in Ghana has concentrated its activities on primary and secondary processing to the detriment of higher-value processing. While this focus has generated positive cashflows for some operations, the lack of a solid in-state value-added wood processing sector denervates the higher export earnings potential by the country and minimizes employment. Studies have shown that the secondary processing of timber concerning lumber (air-dried and kiln-dried), veneer, and plywood remains the most exported product in terms of volume and value for the past two decades (TIDD 2022). New studies have highlighted recent trends in processing emerging forest products such as Bamboo, Rubberwood, smaller-diameter logs, and other Asian and plantation species such as Teak and Cedrella. Indeed, as raw material, wood provides a resilient basis for various conversion processes, which are widely untapped in most African forested countries (FAO, 2013, Adeyoju 1975) such as Ghana. The Forest Development Master Plan (FDMP) 2016-2036 aims to transform the industry into a high-value-added product manufacturer and exporter seeking to re-tool, retain, and standardize by 2030, where downstream processing activities would contribute 60% of the processing chain. This policy brief provides a comprehensive analysis of the latest data on machinery and empirical evidence in the timber trade, to set out transformational insights and pathways for promoting value addition, maximum wood utilization and stimulating investments. The study is part of the monitoring and evaluation framework for the FDMP to monitor the progress of the achievements of financial and technical targets and critical results of Ministry of Lands and Natural Resource (MLNR) operations (FDMP 2016-2036).

Keywords: Ghana, Value-added, Machinery, Technology

CONTEXT

The Timber Industry remains a crucial tenet in the industrialization process of the Ghanaian economy. This sector, however, has undergone rapid market changes since the colonial days when logs were exported in large quantities. With globalization, markets and rapid global construction industry development, consumers have become sophisticated in their needs triggering rapid diffusion of processing technologies in the sector with an ever-increasing product development culture and continuous improvement. As part of the strategic focus of the

Government under the MLNR to facilitate the modernization and re-tooling of the industry by 2030 through investments, technical information dissemination, and the development of regulatory standards, the FDMP underscores the need to undertake a detailed survey of the machinery stock in crucial timber operations (FDMP 2016).



Ghanaian Timber Sector faces Low Downstream Processing Technologies and access to quality raw materials.

Significance of the Work

More than 90% of Ghana's 8.22 million hectares of natural loss have been lost to logging, unstainable production, and use of forest resources (Twum *et al.,* 2019). This has led to degradation and the depletion of plant stock, biodiversity loss, and the release of greenhouse gases into the atmosphere (FAO 2010; INBAR, 2014). The FDMP 2016 stipulates the sustainable use of resources through the development of forest-based industries and the modernization of the tertiary wood industries through retooling, standardization, access to credit, and development funds.



However, to ascertain the level of progress in the modernization and re-tooling of the industry, it is imperative to gather credible data to speak to the state, trends, and inventories of the wood

industries that are instrumental in making targeted interventions to advance 100% wood utilization and sustainable forestry in Ghana.

APPROACH

The research was done through a field survey, desk review, and key informant interviews. The scope of the study was on tertiary processing export industries undertaking the following machining activities; joinery, paneling, profiling, molding, furniture, sanding, and briquette. The current processing technologies of value-added export companies, manufacturing strategies and maintenance levels were assessed. Export and Trade data were used to analyze the growth rate of the wood processing industry engaged in primary, secondary, and tertiary products for the past two decades; the cumulative volume (m^3) and euro value of wood converted into tertiary products, and the export trend of surveyed companies was analyzed using Power BI and Tableau Analytic Software. Other vital aspects affecting the harvesting, processing and sales of wood products such as the level and age of employees, the plantation, and the certification status of companies were analyzed.

KEY FINDINGS

Processing Technologies

The export of value-added wood products is captured mainly from the formal sector which consists of 13 wood processing companies. These companies have downstream processing setups to produce varying effects, such as furniture and furniture parts, flooring, moldings, processed lumber, lipping, doors, door frames, dowels, and briquettes with two levels of technological setups.

1. Companies that use essential portable tools and universal woodworking machines such as Sanders, Borers, Planers, Bandsaw (vertical and horizontal), Spindle Moulders, Jointers, Edgers, Dowel Machines, Tenoners, etc. to produce in small batches usually employing 20-150 persons.
2. Companies that use machines stated in category one and particular purpose machines such as four-sided molders/universal molding machines, copying machines, and computer numerical control (CNC) machines with installed dust extractors and air compressors to produce larger batches usually employing more than 150 persons.



Table 1: Machinery holdings of companies in Ghana

Machine Type	Total Number of Companies	Total Active Machines	Total Inactive Machines	Average Overall Equipment Effectiveness	Average Electricity Needs (kW)
Moulding Machines	13	58	15	71%	40.5
Sanding Machines	11	33	3	68%	37.2
Dowel Machines	5	7	2	75%	36.2
Edger Machines	10	17	5	70%	27.02
Finger joint Machines	9	29	1	67%	34.1
Planning Machines	6	17	3	67%	36.8
MultiRip Machines	5	16	1	59%	25.4
Panel Sizer	4	5	1	57%	39.2
Profiling/CNC/Fluting Machine	1	4	4	43%	49.0
Press	8	20	4	68%	36.9
Tenoner/Mortiser	4	20	1	67%	37.42
Thicknesser	4	6	1	57%	35.2
Cross-cut Machines	12	84	6	69%	32.5
Cyclone/ Drum Drier	1	2	-	80%	50

The machines' average overall equipment effectiveness (OEE) was measured using parameters such as the average waiting time after a breakdown, average waste generated, and the performance rate of each machinery. The OEE of the further processing machines surveyed in the various companies ranged from 43-80%, indicating a percentage range of 59%. This is typical for individual manufacturers in Ghana and means substantial room for improvement. Outdated and power-exhaustive machinery, low employee expertise, and low availability of raw materials are the main factors affecting downstream capacity for companies.

Age and Level of Education of Sawmill Operators

All the interviewed machine operators have a maximum education up to the Senior High School Level with the majority of operators having a Form 4 or middle school level education. At the time of the exercise, the operators, had not received specific skill training but had undergone onsite training where they learned through experience. The age of an operator plays a critical role when it comes to the selection of the machines in which an operator is allowed to operate. More than fifty percent of the respondents were between 40 and 60 years old. Twenty-five percent of operators are within the age class of 30-40 years and 12.8% were within the ages of 60-70 years (Figure 3).

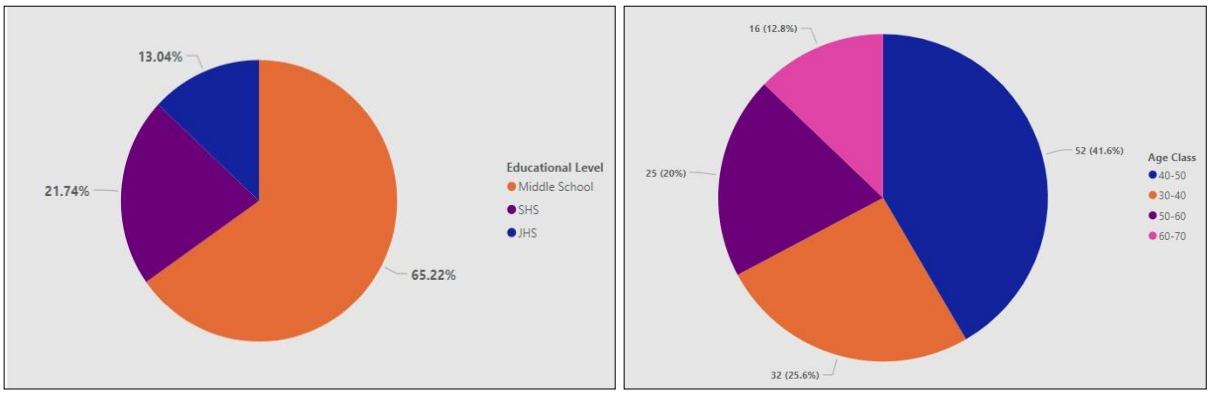


Figure 3: Graph depicting the level of education and Age class of Respondents.

Plantation Status of the Companies

Compared with other continents, industrial wood plantations in Africa have been developed much slower and make only a minor contribution to forest resources. The slowness of creating, developing, and managing plantations within Ghana is a significant concern when looking at the future of Ghanaian Forest Industries. All timber processing companies interviewed expressed concerns about the supply of logs in the medium and long term, even though some companies have concession rights. Plantation status by the surveyed companies is generally slow, with respondents indicating illegal encroachment, poor management, low financial support, and lack of plantation lands as the leading causes of ineffective plantation management.

Processing of Emerging Species

The results on the issue of processing emerging species such as Bamboo, Rubberwood, Palm, Coconut, smaller-diameter logs such as Teak, Eucalyptus, Gmelina, and *Memecylon lateriflorum* for value-added products indicated that none of the companies surveyed had ever processed any of the above-mentioned species. Neither have they processed any wood residue for value-added products except for Sustainable Wood Biomass Company which currently processes wood residue into briquettes. The companies cited minimal technology in processing them in their factories, and lacked strong domestic and international markets for these species, thus, their primary focus still depended on prime commercial species.

Certification, Labelling, and Standardization

Due to environmental concerns and illegalities in the forestry sector, forest product certification has become a significant influencer on domestic and export markets. It has become a rudimentary requirement for any tropical timber-producing country wishing to engage in international export trade. This, in principle, has become a significant barrier for tropical timber-producing countries to dominate the global market. Among the companies surveyed, only five indicated being on a specified third-party certification scheme such as the Forest Stewardship Council. However, these companies were inactive due to financial constraints and bureaucracy (Table 2). The remaining eight companies indicated they were not on any specified certification scheme. They were hopeful that Ghana would be able to issue the Forest Law Enforcement Governance and Trade Action Plan (FLEGT License) sooner in order to improve

confidence among European/foreign buyers and relieve them from the burden of international certification bodies.

Table 2: Further processing Companies in Ghana, their plantation status, market orientation, and International Certification Status

Company	Plantation status	Market Orientation	Number of Employees	International Certification
Western Hardwood	No	Both	22	No
Modern Wood Company	No	Both	-	No
Sarmatex Company	YES	Both	1953	Yes, Inactive
Ayum Forest Products	YES	Both	700	Yes, Inactive
Asuo Bomosadu	YES	Both		Yes, Inactive
John Bitar Company (SUHUMA)	YES	Both	1500	Yes, Inactive
Logs and Lumber Company	YES	Both	-	Yes, Inactive
Sustainable Biomass Solution	No	Both	70	No
Bibiani Logging & Lumber	YES	Both	1500	No
Specialized Timber Products	No	Both	77	No
Ibrahim & Sons Co. Limited	No	Both	80	No
Woodlow Company Limited	YES	Both	36	No
Coppon Wood Processing	No	Both	100	No
Birim Wood Complex	No	Both	-	No

Export Performance of Further Processed Products by Companies Under Study from 2000-2021 in Value and Volume

Export-led initiatives in the marketing and trading of timber play a crucial role in Ghana's economic development strategy. Due to this reason, the government of Ghana has over the years strived to develop policies that would facilitate the efficient use of limited raw materials. Export in further processing by the companies under study has witnessed an unsteady trend in both volume and value for the past two decades (Figure 3). The negative trade balances in further processing are important to understand the key drivers of the value-added sector and the implications to stakeholders.

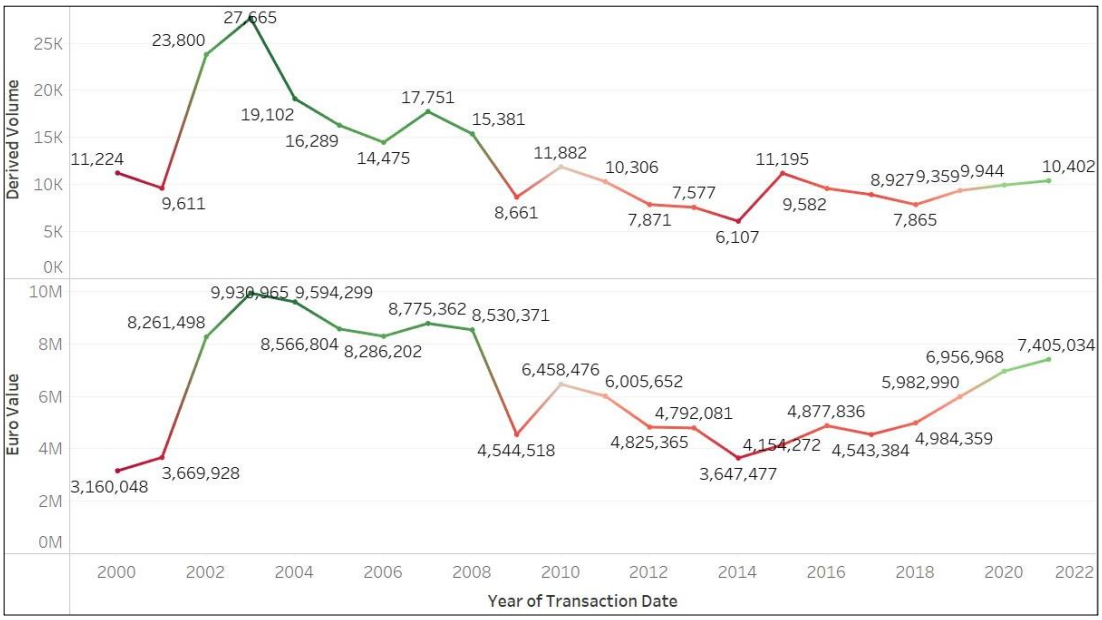


Figure 3: The Export trend of tertiary products by companies under study between 2000-2021.
Credit: TIDD Export Data (2000-2021)

The accrued value in Euro for exported tertiary products including processed lumber, furniture, furniture parts, dowels, flooring, profile boards, and broomsticks increased by 92.01% while export volume in cubic meters trended down by 18.81% between 2000 and 2021. Conversely, accrued books started trending down in 2010, falling by 28.29% in 11 years and the steepest decline in volume occurring between 2007 and 2009 recording from 20,161.94 m^3 to 9,458.15 m^3 (TIDD Export Data, 2022).

Table 3: Trends in the growth rate of export processing firms in Ghana

Industry Type	Number of Firms (2000)	Number of Firms (2010)	Number of Firms (2021)	Annual growth rate (2000-2010)	Annual growth rate (2010-2021)
Primary Processing	5	42	62	23.7%	4.0%
Secondary Processing	203	154	163	-2.7%	-0.6%
Tertiary Processing	39	27	8	-3.6%	-11.5%

(TIDD Export Data, 2022)

Manufacturing Strategy and Maintenance Level of Further Processing Companies in Ghana

There are three main types of manufacturing strategies Make-to-Order, Make-to-Stock, and Make-to-Assemble. Surveyed companies indicated Make-to-Order as their primary production strategy with minimal innovation or design input. While this strategy results in highly competitive prices in the global market for some products such as furniture, the prices are often not profitable, especially for tropical-producing companies such as Ghana which are constrained by additional factors such as depleting prime species, certification, and labeling, limited effective machinery, and highly crafted staff. Achieving Operational excellence with this manufacturing strategy involves the injection of technical design know-how and variety into

the systems capable of effectively meeting global demands and as well as adopting the hybrid Make-to-Order and Make-to-Stock Strategy.

On the other hand, Machinery Maintenance is an essential building block for achieving best-in-class status in the downstream processing of Forest Products. Total Productive Maintenance aims to improve the efficiency of all assets and the life cycle of assets. The various maintenance strategies were grouped into four levels namely; predictive, preventive, reactive, and schedule maintenance. Companies were made to select all the levels that applied to their production strategy. Table 4 indicates companies and their respective responses on the maintenance level, personnel's competency in servicing their machines, and the proportionality of servicing.

Table 4: Table showing the maintenance and servicing strategies used by surveyed companies.

Company	Responsible for servicing	Difficulty in getting a competent technician	Level of maintenance	Origin of Technician	Proportionality of servicing
Asuo Bomosadu Timber & Sawmill Limited	Staff	No	4	Ghana	Weekly
Modern Wood Company Limited	Staff	No	4	Ghana	Weekly
Sarmatex Timber & Plywood Company	Staff	No	4	Ghana	Weekly
Woodlow Company Limited	Staff	Yes	3	Ghana	Seasonal
Specialized Timber Product	Staff	No	4	Ghana	Seasonal
Coppon Wood Processing	Staff	No	4	Ghana	Weekly
Western Hardwood	Staff	No	4	Ghana	Weekly
Birim Wood Complex	Staff	No	4	Ghana	Seasonal
Logs & Lumber Limited	Staff	No	4	Ghana & Expat	Weekly
John Bitar Company	Staff	No	4	Expats	Periodical, mostly weekly
Sustainable Biomass	Staff	Yes	4	Ghana	Weekly
Ayum Forest Products	Staff	No	4	Ghana	Weekly
Bibiani Logging and Lumber	Staff	No	4	Ghana	Weekly

CONCLUSION

The Timber Industry is a critical economic sector for timber-producing countries such as Ghana, yet it faces many challenges that must be assessed critically. Shifts in market demands and the need for sustainable forestry provide a *sine qua non* for differentiated and value-added products. Over the coming years, it is envisaged that the production level of large-sized prime

species from the natural forest is expected to decline. Increasingly, small-diameter logs from fast-growing plantation species, emerging species, and lesser-used species would augment industrial raw material needs. Malaysia provides indicative leadership for downstream processing by installing modern machinery that meets international, commercial, and industrial standards.

Stimulating the performance of further processing companies in Ghana requires rigorous and committed policies and interventions commensurate with customers' tighter, complex and quality control requirements.

POLICY RECOMMENDATIONS

Control and Enforcement of the National Annual Allowable Cut (AAC)

In the mid-'90s, Ghana suspended the exportation of industrial logs to reduce the alarming exploitation of raw materials which exceeded the then-allowable cut of 1.2 million cubic meters. Subsequently, the AAC level was reduced to 1.0 million cubic meters considering the strategic master plan for the forest sector (MLF, 1996; Donkor, 2003). National allowable cuts must guide downstream processing policy that ensures higher conversion rates and quality products. This requires nation's annual permissible amount to show the total number of mills established. Current statistics indicate that Ghana has exceeded its Allowable cut of 1.0 million to 1.5 million cubic meters, i.e., 155% of harvested forest materials from both on-reserves and off-reserves (GWTS 2022). The recent proliferation of small-scale and artisanal mills and illegal chain saw activities play a significant role in the wanton destruction of the forest causing established mills to suffer in accessing quality and desirable raw materials.

Promoting the Utilization of Less-Utilized Species (LUS), Emerging Species, Low-diameter Logs, and Wood Residues

Due to the shortage of desirable species, the government needs to encourage the diversification of species by commissioning detailed studies on the product-specific applicability of LUS, plantation species, and the possibilities of introducing new combinations of materials such as sawdust, branches, plastic, and metals with core wood to Industry Players and Customers alike. Constant market intelligence on emerging species and the provision of Export Incentive Schemes would increase the use of LUS for value-added products among participating countries. Further processing will create opportunities for new applications of LUS. However, for these to be fully exploited, there should be significant shifts in market acceptance and trade flows, both of which are unlikely to happen unless there is a concerted effort by the industry, government, and the international community. There could be an MoU between producing and consuming countries using these species.

Rationalization of Value-Addition Machinery and Retooling Schemes

Providing technical and financial assistance to competitively assessed companies engaged in tertiary processing would contribute to the more significant export of value-added wood products. Supporting distressed companies to re-equip with energy-efficient and optimized machinery would improve efficiency in the production and standardized products. Constantly conducting comparative studies on the availability, costs, and distribution channels of non-wood materials and equipment such as machine spare parts, tools, lubricants, abrasives,

chemicals, finishes, extractors and other critical periodic components used by further processing industries would enhance value addition. The government should consider re-introducing certain subsidies, incentives, and grants schemes such as the Small Producer Scheme, and Kiln and Value Adding Equipment Grants to some competitively assessed companies engaged in downstream processing. The introduction of a Technical Assistance program with a focus on further processing companies and SMEs and the re-introduction and or assessment of incentives in the form of customs import duty exemptions, income tax incentives, tax holidays, location incentives, and capital allowances would further promote value-addition in the wood sector.

Training, Technology Transfer and Capacity Building

Providing training models, materials, and support to companies to improve the skills of employees and employers of companies would enhance the quality and standardization of value-added products. Upskilling operators on optimized sawing, wood drying, saw doctoring, mill management, yard management, factory planning, occupational and factory safety, troubleshooting, correct use of modern adhesives, surface finishes, and hardware fittings for furniture production. Forest Commission (FC) must commit to connecting foreign suppliers to Ghanaian producers in terms of machinery and spare parts by organizing trade shows, seminars, and workshops with the primary aim of connecting buyers and sellers to common bargaining ground, taking advantage of such events to connect top machines and tools manufactures to Ghanaian producers tailored for the Ghanaian Market would go a long way to strengthening downstream processing.

Research, Project Management and Market Development

The forest products industry has evolved from using whole logs and solid-sawn lumber to adopting plywood technology and veneer production. Within the last two decades, newer products and processes have begun taking hold in the markets. Such new products include but are not limited to Oriented strand board (OSB) and particleboard, Laminated strand lumber, Medium Density Fiberboard, Parallel strand lumber, I-joists using veneer lumber flanges and OSB webs, Small-log processing, curve sawing, and Fuelwood products (pellets, briquettes, etc.) Researching the factors that influence the failure or success of these products in Ghana would go a long way to help in decision-making. Nevertheless, conducting studies into the critical role that marketing plays in product development, the feasibilities of setting up such factories, and identifying the factors influencing the production of these products would further the cause of value addition in the Forest Product Sector in Ghana. Research and marketing play an essential role in product development by providing information on customer needs and aiding in product positioning decisions. Research that aims to evaluate product development activities and their effect on business performance measures such as Return on Investment, Return on Sales, Market Share, and growth would go a long way to attract investment into this sector.

Developing and providing models for setting up integrated processing mills for the various product types especially to handle small diameter logs and log-lumber residues to pellets or composites industry for SMEs would assist the industry.

Importing Industrial Wood Products from Other Tropical Producing Countries and Positioning Strong Local Presence

Instead of having only an office in London (U.K) that conducts market intelligence and further promotes and lobbies for the Ghana Forest Industry, Management should consider setting up strategic offices in other Tropical producing countries to facilitate the trade in solid wood products. By setting targets and having a strong presence in countries such as Congo, Nigeria, Gabon, Cote D'Ivoire, etc. the government can use such companies to gather market intelligence, lobby, negotiate, and procure a considerable volume of industrial logs or lumber to feed the ailing and distressed industries in Ghana, taking advantage of the Africa Continental Free Trade and Bilateral Relations. This procedure requires the government (Forestry Commission-TIDD) to negotiate successfully the tariff and non-tariff barriers that may arise with partner countries.

Promotion and Support of Private Plantation, Rigorous Post Plantation Assessment, Government Assistance in Third Party Certifications, and Rigorous Commitment to Achieving the FLEGT Licensing

Explicit recognition of a more stable long-term timber supply from natural forests and various forms of new forest establishments would go a long way to enhance downstream processing in Ghana. Industrial Private Plantation in Ghana is generally slow and poor; developing and encouraging an enabling environment for private sector commercial forest plantations for industrial supply and differentiated product development would facilitate processing exports in Ghana and strengthen the domestic market. Government must support selected companies under transparent and competitive assessment criteria to acquire and manage lands, acquire seedlings, acquire irrigation and plantation machinery, develop plantation, thinning, and harvesting strategies, and provide funds, incentives, and grants in co-managing private plantations. There could be a whole Legislative Instruments (LI) for this strategy. Apart from supporting private plantations and marketing missions, management/ government should consider providing robust support to further processing firms in attaining and strengthening certification of forest management and chain of custody, as well as support, defend, and train companies against falling victim to discriminatory trade practices and negative publicity in international fora.

Attracting and Collaborating Government-Private Sector Investments

The general aura of the industry is relatively low with most investors skeptical about the economic conditions of the country and the triple effects on the industry. Through the government, FC must make efforts to revive means of attracting private investments into the country and as well find ways of convincing fund managers of the need to support responsible production and consumption of timber products. Attracting investments in machinery and spare parts procurement, product development especially in wood energy markets and engineered wood, forest operations, harvesting, and business processes would promote value addition and boost profits.

Credit Authors Statement

Ohemeng, E., Iddrisu, M. N., and Mensah, P. - conceptualization, methodology, research or data collection, statistical analysis, writing (proofreading and editing). and de Melo, R., R.-

administration, supervision, proofreading and editing. All authors read and agreed with the published version of the manuscript.

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