

WORKING PAPER

CLIMATE SMART AGRICULTURE AND CLIMATE INFORMATION SERVICES TRAINING NEEDS FOR KENYA

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Climate Smart Agriculture and Climate Information Services training needs for Kenya

1.0 Introduction

The era of climate change, associated with changes in seasons and rising temperatures, has contributed to the worldwide decline in agricultural productivity despite the increasing global food demand. Addressing food insecurity challenges will require that Africans embrace innovative technologies in agricultural sector. Therefore, the concept of climate-smart agriculture (CSA) is timely and slowly gaining considerable traction in Africa. Indeed, the concept of CSA is intended to build resilience in agricultural systems as the local farmers express their needs for adaptation and the possibility of mitigation in agricultural growth strategies to support food security. As indicated by Waaswa *et al.* (2021) CSA presents the opportunity to meet the world increasing food demands in the face of climate variability, and is responsive to the achievement of Sustainable Development Goals 2 and 13 towards achieving food security and combating climate change. During the meeting involving 21 representatives from nine (9) African countries held in Cotonou, Benin at RUFORUM's Triennial conference on 12-13th Dec 2021, a review was initiated to provide a baseline information on preferred climate-smart agriculture (CSA) practices and existing programmes in institutions of higher learning in the represented countries that included Kenya, Zambia, Ethiopia, Democratic republic of Congo, Benin, Burundi, Uganda, Ghana and Zimbabwe.

Table 1 depicts the prioritization of the eight (8) clustered areas as identified by the different countries during the Cotonou meeting. About 77.8% of the countries proposed Land Restoration and Agroforestry system (LRA) as the priority area number one, except Uganda and Ghana who ranked it priority 2 and 3; respectively. Crop diversification **CD**, Water Harvesting and Management-Small scale irrigation (WHM) and Livestock and Aquaculture Management-**LAM**, were ranked second for Ethiopia, Benin, Burundi and Ghana; Water Harvesting and Management-Small scale irrigation (WHM) was ranked second by Zambia and Kenya. The third priority include ISFM for the 33.3% of the countries followed by CD (22.2%), LAM, MVM and PHM were proposed by 11.1% of the countries. ISFM was not proposed as priority CSA for Zimbabwe only. It was ranked number 1 for Ghana, third for Ethiopia, DRC and Burundi. WHM was also ranked 4 in Burundi. LAM was only ranked third by Zambia. MVM was only proposed and ranked third priority in Benin. A relatively high number of countries (44.4%) ranked ISFM as priority number 4, and Sustainable Bio-Energy-SBE was prioritized by only DRC and Zimbabwe.

TABLE 1: Clustered priority areas for the targeted African countries

Clusters	Zambia	Ethiopia	Kenya	DRC	Benin	Burundi	Uganda	Ghana	Zimbabwe
1) LRA	1	1	1	1	1	1	2	3	1
2) CD		2	3		2	2	1	2	3
3) ISFM	4	3	4	3	4	3	4	1	
4) WHM	2		2			4			
5) LAM	3	4		2					2
6) PHM							3	4	
7) SBE				4					4
8) MVM					3				

Key: Ranking of 1 to 4, where 1 indicates highest rank, while 4 indicates lowest rank in terms of priority

2.0 Climate Smart Agriculture-Relevant Policies in Kenya

Kenya has made considerable steps towards climate change mitigation and adaptation by honoring the Paris Agreement on climate change that was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015. Since then the country has developed and initiated actions to implement various policies and strategies, and particularly those specific to CSA including the Kenya Climate-Smart Agriculture Strategy (2017-2026), Climate Risks Management Framework, Climate Finance Policy, (Tables 2& 3). Table 2 provides various policies relevant to climate smart agriculture in Kenya.

TABLE 2: Policies Relevant to Agriculture and Climate Change

Document	Brief notes about the policy
Kenya Climate-Smart Agriculture Strategy (2017-2026)	It has an objective to adapt to climate change, build the resilience of agricultural systems, and minimize emissions for enhanced food and nutritional security and improved livelihoods
National Climate Finance Policy (2018)	It provides a legal and institutional framework to guide and promote: climate finance flows, tracking of climate finance, engagement with county governments, private sector participation, technology transfer, and equitable benefit sharing from climate change interventions in the country.
Climate Change Act, 2016	The purpose of the Act is to develop, manage, implement and regulate mechanisms that enhance climate change resilience and low-carbon development. It anchors all actions relating to climate change across all sectors. It also creates a climate change governance structure at national and county level. Some Institutions are already in place, such as the Climate Change Secretariat.
Draft National Climate Change Framework Policy (2014)	Policy statements to enhance climate resilience and adaptive capacity; to promote low carbon growth; and to mainstream climate change into the planning processes
National Climate Change Action Plan 2018-2022 (NCCAP executive summary, 2012, and NCCAP, 2013)	Aims to further Kenya's development goals by providing mechanisms and measures that achieve low carbon climate-resilient development. To implement the National Climate Change Response Strategy (NCCRS, 2010)
The Agriculture, Fisheries and Food Authority Act 2013	Provides for "policy guidelines on development, preservation and utilization of agricultural land"
National Climate Change Response Strategy (NCCRS, 2010)	Various measures for adapting agriculture to climate change and for mitigating the emissions of greenhouse gases in agriculture

There are various climate change adaptation and mitigation options recognized within the climate change strategies associated with agriculture in the national climate change action plan in Kenya (Table 3).

TABLE 3: Adaptation and Mitigation Options Recognized Within the Climate Change Strategies Associated with Agriculture in the National Climate Change Action Plan in Kenya

NCCAP Adaptation Options	NCCAP Mitigation Options
<ul style="list-style-type: none"> • Agroforestry • Conservation agriculture • Integrated soil fertility management • Drought-tolerant crops • Water harvesting • Drip irrigation • Price stabilization scheme for livestock • Strategic food reserve • Index-based weather insurance • Climate information • Mainstream climate change into agricultural • Extension services • Grazing systems management, fodder banks and breeding Arid and semi-arid lands (ASALs) • Livelihood diversification 	<ul style="list-style-type: none"> • Agroforestry: Increase tree cover to 10% of total land area • Conservation tillage and limiting use of fire in cropland • Restoration of forest on degraded lands • Avoiding deforestation with REDD+ • Rangeland management • Improved cook-stoves and biogas units

3.0 Training Needs in CSA in the Academic Institutions in Kenya

In line with the new challenges, particularly the biggest of the 21st century, climate change, various institutions of higher learning in Kenya are increasingly integrating climate change adaptation in their degree programmes, and particularly courses that are related to CSA (Table 4). Table 4 shows that, in general, Egerton University, Pwami University and University of Nairobi have several taught course units on the clustered priority areas identified in Benin for Kenya. Only one course unit is being taught at Pwami University on ISFM. At Embu University also only one course unit is being taught on CD and ISFM, while there is no course unit related LRA being taught at Embu University. Few course (1) unit related to CSA and CIS are being taught at Kenyatta University.

It is anticipated that a strong element of CSA features or be infused in the following course units Water Harvesting, Conservation and Storage; Soil and Water Management; Agrometeorology and Climate Change on Crop Production, Agroecology I, II; Water Resources Development and Management; Agroclimatology, Irrigation and Drainage; Climate Change and Development; Soil Fertility and Plant Nutrition; Soil and Water Management; Climate change on Sustainable Agriculture and Agroecology; Conservation Agriculture and Agroforestry Management; Farming Systems and Agroforestry; General soil management; Ecology and agrometeorology; Rangeland Habitat Analysis and Rehabilitation; Hydrology and Agro-Meteorology; Breeding for Resistance to Insects and Diseases.

TABLE 4: Agriculture and Animal Sciences Programmes with Elements of CSA in the Various Institutions of Higher Learning in Kenya

Egerton University							
LRA	Level	WHM	Level	CD	Level	ISFM	Level
Land Evaluation and Land Use Planning (SOIL 440)	Undergraduate (UG)	Soil, Plant and Water analysis (SOIL470)	Undergraduate (UG)	Dryland Agriculture (AGRO 401)	Undergraduate (UG)	Soil Characterization and Classification (SOIL340)	Undergraduate (UG)
Hydrology (AGEN 356)	Undergraduate (UG)	Water Resources Engineering (AGEN 556)	Postgraduate (PG)	Cropping Systems (AGRO 482)	Undergraduate (UG)	Soil Fertility and Plant Nutrition (SOIL 350)	Undergraduate (UG)
Irrigation and Drainage i/ii (AGEN 455/555)	Undergraduate (UG)	Agricultural and Domestic Waste Management (AGEN 557)	Postgraduate (PG)	Agroclimatology (AGEN 374)	Undergraduate (UG)	Integrated Organic Farming Systems (SOIL 351)	Undergraduate (UG)
Land Use Planning (AGEN 551)	Postgraduate (PG)	Soil and Water Management (AGEN 375)	Undergraduate (UG)	Climate Change and Development (GEOG 322)	Undergraduate (UG)		
Environmental Management Principles & Practices (GEOG 411)	Undergraduate (UG)	Irrigation and Drainage (AGEN 376)	Undergraduate (UG)				
Pwani University							
LRA		WHM		CD		ISFM	
Introduction to Soil Science and Landforms in current climate change (KSW B101)	Undergraduate (UG)	Soil and Water Management (KSW B302)	Undergraduate (UG)	Climate change on Sustainable Agriculture and Agroecology	Undergraduate (UG)	Soil Fertility and Plant Nutrition	Undergraduate (UG)
Land Evaluation for Agricultural Use	Undergraduate (UG)	Principles of Irrigation and Drainage	Undergraduate (UG)	Beverages, Medicinal and Nut Crops	Undergraduate (UG)		

Farming Systems and Agroforestry	Undergraduate (UG)	Aquatic Resource Management	Undergraduate (UG)	Industrial Crops	Undergraduate (UG)		
		Irrigation, Drainage and Agrometeorology	Undergraduate (UG)	Vegetable, fruit and flower production	Undergraduate (UG)		
Environmental and Resource Economics	Undergraduate (UG)	Utilization and Management of Wetland Ecosystems	Undergraduate (UG)	Indigenous Vegetable Production	Undergraduate (UG)		
Conservation Agriculture and Agroforestry Management	Undergraduate (UG)	Hydrology and Agrometeorology	Undergraduate (UG)	Herbs and Spices	Undergraduate (UG)		
Embu University							
LRA		WHM		CD		ISFM	
		Water Harvesting, Conservation and Storage (AWM 307)	Undergraduate (UG)	Agrometeorology and Climate Change on Crop Production (ACA 601)	Postgraduate (PG)	Agroecology I, II (AEM 102, 203)	Undergraduate (UG)
		Water Resources Development and Management (ALM 603)	Postgraduate (PG)				
University of Nairobi							
LRA		WHM		CD		ISFM	
Land Degradation & Management of Problematic Soils (ASS 403)	Undergraduate (UG)	Irrigation and water management (AEB 302)	Undergraduate (UG)	Seed science and technology (ACS303)	Undergraduate (UG)	Soil biology and biotechnology (ASS 304)	Undergraduate (UG)
Rangeland Habitat Analysis and	Postgraduate (PG)	Soil and Water Conservation (ALM 607)	Postgraduate (PG)	Breeding for Resistance to Insects &	Undergraduate (UG)	Soil Fertility and Plant Nutrition (ASS 606)	Postgraduate (PG)

Rehabilitation (ARM 606)				Diseases (ACP 301)			
Dryland improvement and rehabilitation (ARM 404)	Undergraduate (UG)	Soil-Water-Plant Relations (ALM 601)	Postgraduate (PG)	Food security, livelihoods and nutrition (AFN 311)	Undergraduate (UG)	Soil Biology and Biochemistry (ASS 604)	Postgraduate (PG)
Dryland Agroforestry (ARM 307)	Undergraduate (UG)	Hydrology & Agro-Meteorology (ASS 405)	Undergraduate (UG)	Ecology and agrometeorology (ACS 204)	Undergraduate (UG)	Soil Survey, Classification and Land Evaluation (ASS 605)	Postgraduate (PG)
Principles of resource use and management (AEC 305)	Undergraduate (UG)			Plant breeding (ACS 302)	Undergraduate (UG)		
Kenyatta University							
LRA		WHM		CD		ISFM	
Agroforestry development (KST 422)	Undergraduate (UG)			Field crop production (KRM 303)	Undergraduate (UG)	General soil management (KRM 401)	Undergraduate (UG)

4.0 Priority Training Areas for Kenya

The needs assessment revealed a number of capacity gaps on climate smart agriculture & climate information services, which are summarized as priority training areas for Kenya in Table 5.

TABLE 5: Priority Training Areas for Kenya

Training theme	Description	Beneficiaries	Priority level for Kenya
Practical understanding of the CSA approach.	The CSA and CIS approach is obviously attractive and compelling in principle, but its application in the context of diverse agro-ecologies and highly heterogeneous farming systems, conditions and socio-economic policies still requires concrete success stories. Gathering clear empirical messages to inform farmers and policymakers and support scaling-up initiatives will depend on how well the CSA concept is understood in practice, allowing for continuous two-way adaptations and feedback mechanisms between researchers and practitioners, farmers and policymakers. There are also gaps on design thinking for CSA and CIS.	Staff and students	High
Climate information service and real-time agricultural data	Due to the increasing number of disasters and weather extremes on the continent, there is need to increase access to climate information services for the different stakeholders and use in agriculture. Climate information risk and management	Staff and students	High
Agriculture-livestock aquaculture integration	Previous initiatives have not included aquaculture in the crop-livestock integration projects. With an increasing expansion of aquaculture on the continent, training is necessary to support effective integration of aquaculture to already adopted integrated farming systems, Capacity building on aquaculture value chain initiatives	Students	High
Capacity building on the elaboration of effective CSA and CIS-specific policies	Several academicians have not been involved in policy formulation process. This is key in the promotion and adoption of CSA practices/technologies and/or CIS tools	Staff and students	Medium

Principles of agro-ecology farming system	Conducting agricultural activities on the basis of ecological principles is crucial for maintenance of healthy ecosystems at the same time addressing the challenges for food shortage and ecosystem degradation. There is a need to strength this aspect in training of future lecturers and students.	Staff and students	Medium
Assessment of carbon sequestration and greenhouse gas emission potential by different agro-ecologies and farming systems	The knowledge on how the carbon footprint can be estimated needs to be added to the university curricula and more practical work included.	Students	High
Effective seed delivery systems of resilient crop varieties	Crop productivity in a climate-stress scenario is dependent on the resilience of varieties used. In eastern DRC, seed production system is not operational. The training shall focus on how to produce seeds, and development a functional seed delivery system for such resilient varieties is crucial.	Staff and students	High
CSA and CIS-oriented extension strategies	Staff and students need to be equipped on the most appropriate extension strategies to increase chance of CSA and CIS practices' uptake by farmers	Staff and students	High
Digital-based platforms for plant and animal disease monitoring and control	With the increasing volume of data being generated across the country and the opportunities provided by the communication technologies, it is important to equip staff and students on how digital platforms could help for timely monitoring and information sharing on emerging animal and plant diseases.	Staff and students	High
Gender issues and CSA	Staff and students need more awareness on how women can be sustainably supported through a community-centered approach to adopting and adapting livelihood strategies in innovative ways, based on current and future climate change scenarios.	Staff and students	Medium

Information and Communications Technology (ICT) and CSA practices dissemination	These technologies have been instrumental in disseminating CSA practices and climate information in other African countries. Yet, these are still unknown on the continent and lack in the university curricula.	Staff and students	High
Agricultural and agroforestry land suitability analyses using GIS and remote sensing tools	Due to high cost of field assessment, the use of GIS and remote sensing tools in data-scarce context could help rapidly identify and quantify suitable lands for agricultural activities at low cost.	Staff and students	High
Biofertilizer and biopesticide development	Sub Saharan African is among regions with lowest external farm inputs worldwide because of poverty among farmers and cultural (belief system) resistance. Equipping staff and students on alternative approaches could help boost adoption and farm productivity on the continent.	Staff and students	High
Agricultural waste recycling options	Adequate options for waste recycling could help reduce pollution and increase farmers' food and income security on the continent. Adding economic and eco-friendly recycling options (such as mushroom production, animal feed processing, etc.) in the curricula is important.	Students	Medium
Cost-effective renewable energy and biogas production	The use of renewable energy such biogas is an effective mean of reducing pressure on forests and other natural resources in rural areas of the continent.	Students	High
Permagarden farming approaches	Crop mixing is among climate change resilience strategies. Understanding on how the permagarden can be economically practiced on the continent is crucial since agriculture is mainly conducted on small plots by resource-poor smallholder farmers.	Staff and students	Medium
Microdosing and micro-irrigation systems	The application of fertilizer and water is often inefficient due to misuse of products and the dosage is not well practiced by farmers.	Students	Medium

	Training students on micro dosing and micro-irrigation systems would help fix the situation in the near future.		
Crop diversification and climate-resilience potential of neglected and underutilized crop species	Neglected and underutilized crops, as the most adapted to local agricultural systems and climates, are now perceived as a mean to minimize adverse effects of climate changes. Yet, their knowledge is poor among staff and students.	Staff and students	Medium
Conservation and enhancement of biodiversity and ecosystem services	Mismanagement of biodiversity is often due to lack of information on ecosystem services they provide. Increasing awareness on the topic will help student make reasonable decisions in their carrier vis-à-vis the conservation and enhancement of biodiversity and ecosystem services on the continent.	Staff and students	Medium
Improve policy coordination and strengthen local, national and regional institutions to support implementation of CSA and CIS	Without appropriate institutional structures in place, CIS and CSA-related innovations can overwhelm smallholder farmers. Training on how to improve information dissemination; to leverage resources and organizing markets; provide insurance to address risks associated with climate shocks are important.	Staff	High
Applications of Biotechnology in CSA	There is a need to learn about the science behind biotechnology application in area of CSA. This include employ biotechnology to enhance crop productivity and quality; build positive attitude concerning bioethics in relation to biotechnology.		
GIS and remote sensing in CSA amd CIS	Use of GIS and RS will support CSA through increased access to CIS and facilitate precision and digital agriculture.	Staff	
Indigenous knowledge systems (IKS) on land use and CSA	Tapping on IKS for CSA and CIS	Students and staff	Medium
Ethnobotanical plant use and ethnoveterinary medicines for crop and livestock production	The training will focus on promoting the use of environment friendly and locally resources	Staff	High

	for pest and disease control in crops and animals.		
Climate smart post-harvest processing and storage techniques	A variety of these techniques are now available but known by end-users.	Students and staff	High
Breeding of adapted livestock breeds and crop varieties	Various approaches promoting animal breeds and crop varieties that are adapted to the region exist and need to be disseminated.	Staff	High
CSA and CIS and the Development agenda	Mainstreaming the development agenda in CSA and CIS and vice versa is crucial for achieving local, national and international sustainable development agenda.	students and staff	High
Climate Finance for CSA	Inadequate knowledge on financial opportunities for CSA projects	Students and staff	High
Statistical downscaling and modelling of climate data	Techniques/approaches converting satellite data into location specific data for climate change analysis are known by few professionals.	University staff and students, experts in line ministries & other institutions	High
Design thinking and Digital Technologies for CSA and CIS	Build capacity in App development and application for CSA and CIS is key for CSA and CIS promotion and adoption.	Students and staff	High
The role of the media in CIS and CSA promotion	Enhancing the role of the media as a tool in promoting and raising awareness on climate actions among stakeholders	Students, staff and climate experts/practitioners	High
Climate Finance for CSA and CIS	Funding opportunities for CSA and CIS initiatives need to be disseminated.	Students and staff	High
CSA policy for strengthening academia-policy nexus and partnerships	Continued dialogue and collaborations are crucial for effective and dynamic climate-smart solutions. There is also need to address gaps through science-policy interactions.	University staff and policy makers	Medium
CSA and the Urban agenda	Promoting the practice and adopt of climate smart urban farming that ensures environmental protection and food and nutrition security	Students and staff	Medium

5.0 Interventions Needed to Increase Adoption of CSA Practices and CIS Tools

Table 6 presents the various interventions needed to increase adoption of climate smart agriculture and climate information services tools in Kenya

TABLE 6: Needed Intervention to Increase Adoption of CSA Practices and CIS Tools

Proposed Intervention	Community level	Community leaders	Civil society actors	Academia/Research	Extension service	Decision makers	Media	Private sector	Politicians
Improved access to information for adaptation and mitigation, compilation of information from different areas	Awareness, Training, demonstration, monitor, exchange visit, experiential learning, mapping existing knowledge (SK and IK) and CSA practices, packaging of CC and weather data,	Awareness, involvement	Awareness, Map engagement to CSA (intervention, funding), Institution strategy/priorities	Awareness and empower acad. staff, Inventory of existing knowledge, Map existing programme, courses and researchers, mainstream CSA in curriculum, Co-generation of knowledge with media, Communication channel being used, recognition of IK, Develop reliable weather data and improve access to	Awareness, training, Map existing knowledge on CSA, distribution of extension staff, approach for extension	Awareness of CSA, them to develop CSA strategy	Awareness of CSA, map the communication channel and packaging, support training on CSA, engaging them in dissemination, support agriculture graduates in journalism	Awareness, Training,	Awareness, Advocacy and lobbying

				climate info, encourage multi-disciplinary teams, prioritize research on CSA					
Review and compilation of existing information on CSA practices and CIS tools	Provide site (crop/livestock) specific IK and CSA; demonstration for validation	support the collection of information	support the collection of information	Review and compile info on CSA for all identified stakeholders, develop policy, white papers	Participate in collection and compiling of information	Support the collection and compilation of CSA information	Support the collection and compilation of CSA info, strengthen info flow	Support (through participation and funding) collection and compilation of info	Approved and endorse the policy recommendations on CSA practices
Improved understanding of the CSA and CIS	Awareness, Training,	Awareness, involvement	Awareness, Training,	Awareness, Capacity building (tailored made training), mainstreaming SA and CIS into curriculum	Awareness, Training,	Awareness, Training,	Awareness, Training,	Awareness, Training,	Awareness, Advocacy and lobbying
Need for Reliable funding/ Gvt support	Promote innovation (IP, market based), in-kind contribution for CSA demonstration	facilitate (mobilizing, champions) the implementation of CSA	Awareness Prioritization of CSA (integrated into the IP), contribute funds towards CSA adaptation	Involved in CSA proposal writing (Training and awareness on available call), demand driven research, allocate funds	Facilitate (financial) the Linking of various actors on CSA, promote the creation of network	Contribute financially towards facilitation of CSA adaptation of strategies. creation of an enabling environment	Mobilize resources for awareness and adoption of CSA	Play an active role in IP, contribute to adoption of CSA, mobilize resources for CSA , build on	Contribute financially towards facilitation of CSA adaptation of strategies. creation of an enabling

				for CSA research, mobilize resources for CSA labs		for actors to focus on CSA, Engage them to get support for agriculture in terms of budget and CSA, support subsidies in CSA, tax exemption, provide incentive to actors to participate and contribute to CSA		PPP to avail resources for CSA adaptation	environment for actors to focus on CSA, Engage them to get support for agriculture in terms of budget and CSA, support subsidies in CSA, tax exemption, provide incentive to actors to participate and contribute to CSA
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6.0 Conclusion & Recommendations

Based on the foregoing background, there is need to:

- Develop short courses, and (or) infuse the elements of CSA and CIS in existing degree programs in selected pilot Universities since there is limited emphasis on CSA and CIS in degree programmes.
- Provide empirical evidence and demonstrations to support the training and practice. This will necessitate leveraging research funds to strengthen existing research evidence to guide training;
- Build adequate expertise/capacity in various aspects of CSA and CIS among the academia to further research and training on CSA & CIS. This calls for development of new degree programmes that will lead to training of critical mass of experts in CSA;
- Strengthen linkages between the higher learning institutions and the TVETs for efficient transfer of knowledge and skills to end-users;
- Establish adequate resources and infrastructure to support CSA & CIS at the learning institutions.
- Establish learning platforms with focus on CSA and CIS to enable wide and interactive engagement with knowledge, therefore need for multi-stakeholder knowledge & information sharing platform to enable learning among various stakeholders.



AICCRA
Accelerating Impacts of CGIAR
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About AICCRA

Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) is a project that helps deliver a climate-smart African future driven by science and innovation in agriculture.

It is led by the Alliance of Bioversity International and CIAT and supported by a grant from the International Development Association (IDA) of the World Bank.

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