UNIVERSITY OF NAMIBIA

SAM NUJOMA MARINE AND COASTAL RESOURCES RESEARCH CENTRE

(SANUMARC)

An Operating Unit of the United Nations University - Institute for Natural Resources in Africa (UNU-INRA)

In accordance with its motto "Education, Service and Development" the University of Namibia's programmes have been designed to meet national human resource requirements through quality teaching, research, consultancy and community service. Through its competent and dedicated staff and quality infrastructure, the University has been serving the nation in various ways, and has contributed significantly to national reconstruction and development since its inception in 1992. The University realized that science and technology education and research is the engine that would drive economic development and growth through sustainable and responsible utilization of the country's under-utilized marine and coastal resources. Consequently, the University of Namibia established the Sam Nujoma Marine and Coastal Resources Research Centre in Henties Bay, to promote research and development activities in this field. Below is a brief description of the Centre and its tasks.

1. **THE VISION:** To become a centre of excellence in science and technology research in marine and coastal resources, in order to contribute to global efforts to promote food security and eradicate poverty.

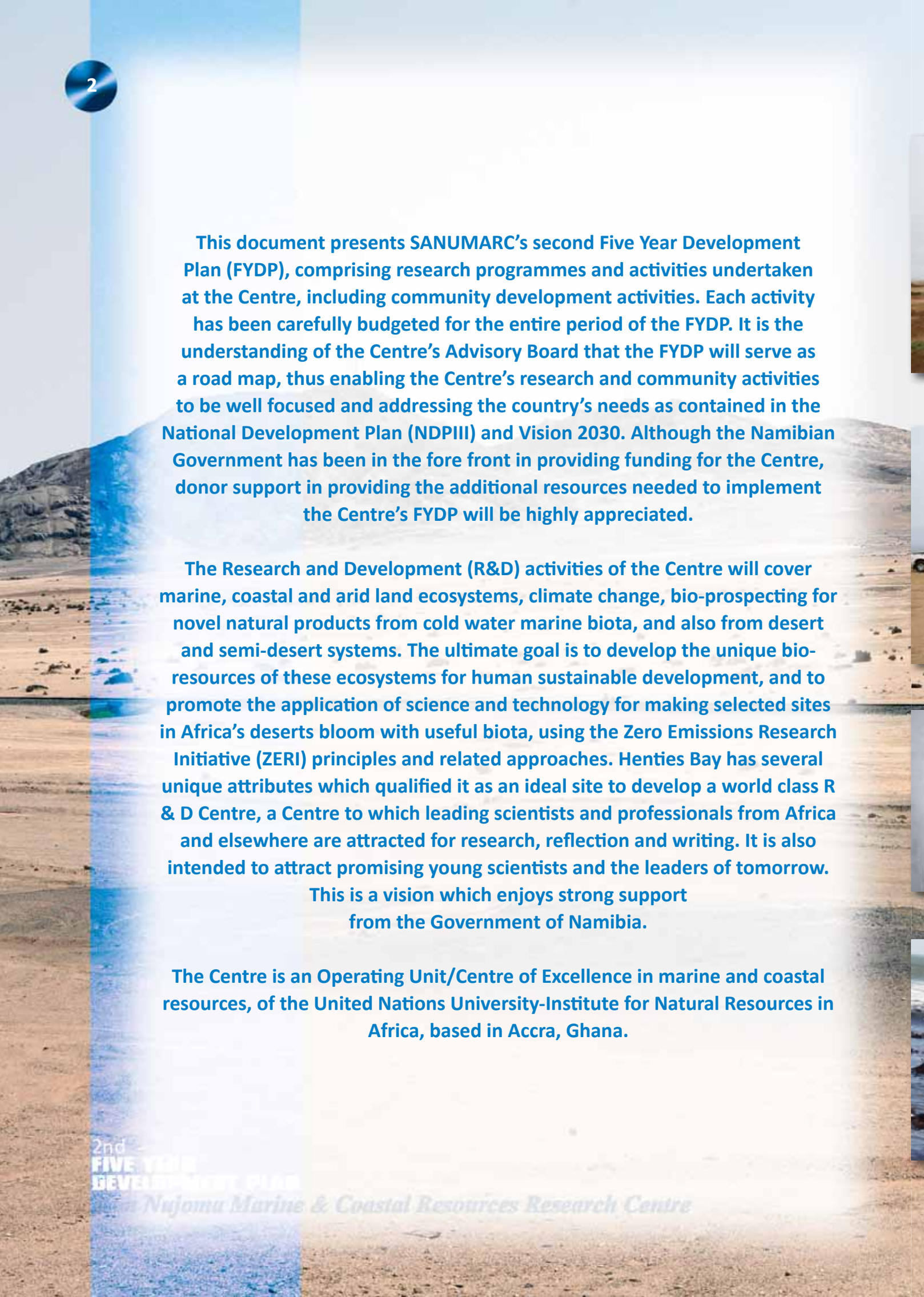
2. **MISSION:** To promote sustainable development and responsible utilization of marine and coastal resources based on environmentally sound management for the benefit of Namibia and the people of the SADC Region.

3. **STRATEGY:** Use development plans (Five Year Development Plans) and annual work plans to implement output-oriented inter-related research and research related programmes, each of them focused on a few carefully selected thrusts or objectives.

This document presents SANUMARC's second Five Year Development Plan (FYDP), comprising research programmes and activities undertaken at the Centre, including community development activities. Each activity has been carefully budgeted for the entire period of the FYDP. It is the understanding of the Centre's Advisory Board that the FYDP will serve as a road map, thus enabling the Centre's research and community activities to be well focused and addressing the country's needs as contained in the National Development Plan (NDPIII) and Vision 2030. Although the Namibian Government has been in the fore front in providing funding for the Centre, donor support in providing the additional resources needed to implement the Centre's FYDP will be highly appreciated.

The Research and Development (R&D) activities of the Centre will cover marine, coastal and arid land ecosystems, climate change, bio-prospecting for novel natural products from cold water marine biota, and also from desert and semi-desert systems. The ultimate goal is to develop the unique bio-resources of these ecosystems for human sustainable development, and to promote the application of science and technology for making selected sites in Africa's deserts bloom with useful biota, using the Zero Emissions Research Initiative (ZERI) principles and related approaches. Henties Bay has several unique attributes which qualified it as an ideal site to develop a world class R & D Centre, a Centre to which leading scientists and professionals from Africa and elsewhere are attracted for research, reflection and writing. It is also intended to attract promising young scientists and the leaders of tomorrow. This is a vision which enjoys strong support from the Government of Namibia.

The Centre is an Operating Unit/Centre of Excellence in marine and coastal resources, of the United Nations University-Institute for Natural Resources in Africa, based in Accra, Ghana.



Overview of Work Programmes

Sam Nujoma Marine and Coastal Resources Research Centre (SANUMARC) at Henties Bay.

Background

Since its construction in 1999, the Centre has been used as a base for a number of visiting researchers, interested in the unique fauna and flora of the Namibian Coast. In 2003, it was decided to develop research programmes that would more directly address national and regional development needs. A stakeholders' workshop was held in Henties Bay in late Augustus 2003, and brought together people from Namibia's academic institutions, government, and the private sector. The workshop identified research priorities in a number of areas. Community outreach in support of various community development and training activities in Henties Bay and beyond, was added as an eight area. A second stakeholder's workshop was held in June 2008, where the existing research priorities were reaffirmed, and new ones where added.

The Keto Mshigeni Mariculture Research Complex at SANUMARC, Henties Bay.

Marine Science Research

The Centre has embarked on research programmes in marine science disciplines including the biology, ecology and nutrition of marine animals and plants and the biogeochemistry dynamics of their environment.

The perlemoen abalone (*Haliotis midae*) does not occur naturally in Namibia, but has been identified by the private sector as a major development opportunity. One farm is already operating in Luderitz and many more have been proposed. Initial research on the perlemoen has concentrated on comparing growth on different diets, both formulated and natural. New areas of research include aspects of the breeding and on-growing of the perlemoen and Japanese (*Haliotis discus hannai*) abalone species.

Measuring Abalone growth fed local seaweeds.

Research to determine the suitability of some endemic finfish species for mariculture is ongoing, and has focused on the reproductive biology, induced spawning and larval rearing of silver kob (*Argyrosomus inodorus*). Other potential mariculture species include finfish such as the blacktail (*Diplodus sargus capensis*) and bivalve shellfish such as the white sand mussel (*Donax serra*) and clam (*Venerupis corrugates*).

Seaweed is farmed, collected from the beach and harvested in the Luderitz area. The Centre has assessed the seaweed resources in the area for sustainable harvesting, and future research will focus on developing culture techniques for economically important species, and promoting the better utilization of seaweed and seaweed products.

Measuring kelp frond re-growth.

The Centre also maintains micro-algae stock cultures of species useful for mariculture. This work will be expanded to include the culture of other useful species, and the identification and isolation of local species of potential value.

Harmful algal blooms and sulphur eruptions are a cause for concern to many aquaculture operations in Namibia and the Centre intends to carry out research on the biological, geological, physical and chemical processes that drive these events, in order to devise mitigating measures against their effects on living organisms.

Newly developed steam pot for sterilizing mushroom culture medium.

Mushroom Research & Development

The University has been spearheading the research and development of mushroom culture in Namibia and along the Namibian coast in particular. The cool, humid environment at the coast provides more favorable conditions for the growth of some species, but obtaining suitable substrates has been the challenge. Research will focus on three topics:

- Evaluating the suitability of locally available substrates for culture of oyster mushrooms;
- Identification of indigenous mushroom species for cultivation at the coast; and
- Evaluation of different designs of low-cost mushroom houses.

Using Old-Man Salt Bush as a windbreak for olive cultivation.

Coastal Agriculture and Plant Biodiversity

The desert climate of the Namibian coast would seem to make it an unpromising location for agricultural activities, but there are areas of opportunity. Five of these areas are being investigated at the Centre:

- Bio-saline agriculture, particularly the cultivation of useful, salt tolerant crops;
- Plant biodiversity, mainly the cultivation of useful indigenous desert plants;
- Forestry and dune stabilization, involving the cultivation of shrubs and trees for desert greening and sand dune stabilization;
- Horticulture, with the aim of perfecting efficient techniques for the cultivation of high value plant species; and
- Small-scale animal husbandry; firstly studying the feasibility of such an activity at the coast

Desert garden consisting of locally selected species.

Biogas Digester installed at the Omdel settlement in Henties Bay.

Renewable Energy Sources

The Centre has been involved in the development of inexpensive biogas technology at the Henties Bay Clay House Project, and will continue to examine the feasibility of harnessing new sources of renewable energy at the coast. Proposed projects include:

- Trials of small scale wind generators under Namibian conditions;
- Promotion of the use of biogas energy from domestic waste; and
- Investigating the feasibility of, and setting up a pilot scale wave energy generator near the Centre

It is recognized that there is a great deal of international expertise in this field, and collaboration with institutions from other countries will be encouraged

Fog Harvesting to get fresh water, at SANUMARC.

Water Resources

The Centre is fortunate to be located over one of the coastal region's major freshwater aquifers, but generally fresh water is a scarce resource. In contrast, the Atlantic ocean provides an inexhaustible supply of seawater. Research will therefore focus on desalination, with three projects:

- Use of filter feeders (oysters) for pretreatment of water for desalination;
- Evaluation of small solar stills for meeting domestic/ drinking water needs; and
- Research on membranes for reverse osmosis.

Preliminary research has already been carried out on fog harvesting at the Centre, when an attempt was made to correlate dew deposits with weather conditions. Additional research will include investigating collector materials that can withstand local climatic conditions.

The Namibian coast provides a varied environment for research.

Coastal Environment

The Namibian coast provides a unique and varied environment for research. Under this programme, meteorological data is being collected for the Henties Bay area from a weather station that has been erected at the Centre, for long term evaluation of climate change. Other aspects of the programme include:

The investigation of micro-climates around Henties Bay;

- Geomorphology - specifically determining changes in the coastal landscape over time and identifying the causes; and
- Corrosion – investigating the mechanisms and testing various protective coatings designed to prevent corrosion and the deterioration of buildings in the harsh coastal climate.

The Centre also encourages collaborative projects in these and other areas.

Henties Bay community mushroom project at Tulongeni garden.

Henties Bay community garden project at Tulongeni garden.

Community Outreach

The Centre actively supports the University of Namibia's policy on community service, by continuing to assist communities in the coastal region and beyond. The Centre's aim is to contribute to the national efforts of poverty alleviation, by providing technical expertise and, where appropriate, helping to source development funds for projects. Activities include:

- Promoting mushroom production for food and as a source of income;
- Assisting horticulture development projects;
- Promoting the use of biogas as a low cost source of energy; and
- Promoting the collection and use of beach-cast seaweed.

FIVE YEAR DEVELOPMENT PLAN (FYDP) LOGFRAME 2009 – 2013

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
1. MARINE SCIENCES **1.1 MARICULTURE** **1.1.1 Shellfish** To conduct research to support local & exotic shellfish cultivation	MSC.MAR. SHE	▪ Identification of suitable mariculture candidates ▪ Captive spawning of shellfish ▪ Improved production	➢ Introduction of local & exotic potential mariculture species ➢ Brood stock conditioning ➢ Captive propagation ➢ Genetic breeding programme (e.g. oysters) ➢ Larval rearing ➢ On-growing studies ➢ New uses for product (e.g. mussels)	➢ New species introduced ➢ Old shellfish culture methods improved ➢ New culture methods developed ➢ Farmers diversify shellfish cultivation ➢ Improved growth & survival due to breeding programme ➢ New products & markets identified for Namibian shellfish	➢ Potential new species exist ➢ Shellfish expertise available ➢ Funding for research available
1.1.2 Abalone To conduct research to support abalone cultivation	MSC.MAR. ABA	▪ Suitable abalone diets ▪ Captive spawning ▪ Larval settling and rearing ▪ Larval weaning ▪ Improved production	➢ Feeding trials ➢ Introduction of new species ➢ Brood stock conditioning ➢ Captive propagation ➢ Larval rearing ➢ On-growing studies	➢ Experimental feeds adopted by local farmers ➢ Adult abalone induced to spawn ➢ Local farmers accept introduced abalone species	➢ Constant supply of local & exotic abalone available for research ➢ Approval to import new species granted ➢ Funding for trials available

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
1.1.3 Finfish To develop and demonstrate techniques to cultivate finfish	MSC.MAR. FIN	▪ Reproductive biology of local species investigated ▪ Controlled spawning techniques developed ▪ Feeding of larvae and juvenile fish researched ▪ Optimum rearing conditions developed ▪ Diseases and parasites studied ▪ Economic viability of ranching evaluated	➢ Feeding trails ➢ Develop husbandry techniques ➢ Captive propagation ➢ Screening and disease trails ➢ Medication ➢ Assessment of markets and market costs	➢ Reproductive biology understood ➢ Spawning in captivity achieved ➢ Larvae reared on live feeds ➢ Weaning diets successfully introduced ➢ Juveniles reared to market size ➢ Growth & survival maximized ➢ Production cycle closed (larvae to brood stock) ➢ Disease treatment protocols developed ➢ Production costs evaluated	➢ Funding approved by CFTC ➢ Collaboration and funding by the fishing industry ➢ Broodstock availability ➢ Farmed species accepted by markets
1.1.4 Seaweed *1.1.4.1 Cultivation* To develop techniques for the cultivation of economically important seaweeds in Namibia	MSC.SEA. CUL	▪ Seaweed farming techniques established ▪ Suitable species for cultivation identified	➢ Collect plant material for culturing ➢ Evaluate growth rates of various species under different conditions ➢ Develop onshore culture technologies ➢ Assess the nutritional and medicinal qualities of various seaweeds ➢ Investigate seaweed culture integrated with other aquaculture production	➢ Results of pond culture trials published ➢ Farmed seaweed analyzed for useful compounds ➢ Seaweed cultured in commercial fish farm wastewater ➢ Onshore culture of seaweed in ponds proved viable	➢ Suitable onshore culture system can be developed ➢ Research students and funding available
1.1.4.2 Utilization To promote the better use of seaweed and seaweed products	MSC.SEA. UTA	▪ Potentially useful seaweeds available in Namibia documented ▪ Possible uses of seaweed and seaweed products identified	➢ Evaluate seaweed as an improvement to soil conditions ➢ Evaluate seaweed as a livestock feed supplement ➢ Education awareness on the usefulness of seaweeds	➢ Trial tests published ➢ Local farmers incorporate seaweed as fertilizer ➢ Local farmers incorporate seaweed as feed supplement ➢ Brochure/poster on seaweed utilization printed and published	➢ Livestock farmers cooperate with trials ➢ Beach cast seaweed available

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
1.1.5 Micro-algae To research, evaluate and access potentially useful micro-algae species for cultivation	MSC.SEA. MIC	▪ Stock of useful species of micro-algae cultivated and maintained ▪ Medicinal and nutritional value of various local algae species determined	➢ Collect and maintain stocks of useful species of micro-algae ➢ Isolate potentially important local micro-algae ➢ Evaluate different micro algae species for medicinal and nutritional purposes ➢ Create awareness of potentially useful algae species	➢ Stock cultures of micro-algae species maintained at SANUMARC ➢ Analysis of useful products carried out ➢ Information on micro-algae culture disseminated	➢ Sock cultures available from overseas ➢ Adequate biochemical analysis skills available ➢ Taxonomy of local species available
1.2 BIOGEOCHEMISTRY To research the biological, geological and physical processes that drive the chemical cycling in marine systems and their effect on living organisms	MSC.BGC	▪ Profile of harmful algae compiled ▪ Dynamics of sulphur eruptions understood	➢ The effect of HAB & sulphur eruptions on shellfish physiology ➢ The development of an early warning system for sulphur & HAB events	➢ Mitigating techniques & technologies in place the combat sulphur & HAB events ➢ Early warning monitoring buoy moored in Walvis Bay ➢ Monitoring with MFMR strengthened	➢ Collaboration with other institutions takes place ➢ Sulphur & HAB events can be modeled ➢ Remote monitoring technology available & suitable for Namibian coast
2. MUSHROOMS **2.1 SUBSTRATES** Promote and develop mushroom production	MUS.SUB	▪ Optimal substrates from coastal resources identified and tested	➢ Evaluate organic materials to be used as substrates ➢ Test different combinations of substrate on mushroom growth ➢ Test quality and nutritional value of mushrooms grown on various substrates ➢ Analyze economic viability of mushrooms cultured on different substrates ➢ Assess mushroom yield per mass of substrate	➢ A growing interest in mushroom farming at the coast ➢ Locally available substrates are used to grow mushrooms	➢ Substrate and spawn availability are not limiting factors

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
2.2 SPECIES To collect, identify and evaluate medicinal & nutritional value of indigenous mushrooms	MUS. SPE	▪ Identification of nutritional and medicinal mushroom species suitable for cultivation ▪ Identification of Namibian species suitable for cultivation ▪ Methods and techniques of mushroom cultivation developed ▪ Nutritional and medicinal properties tested ▪ Economic analysis of various species	➢ Document local mushroom distribution and indigenous knowledge of their uses ➢ Collect local mushroom species from the field ➢ Isolate and cultivate spores of local species ➢ Fortify exotic mushrooms with nutrients such as iodine, zinc, selenium, etc ➢ Chemically analyze indigenous mushrooms ➢ Dry and keep reference samples of indigenous mushrooms ➢ Test exotic mushroom species for suitability to local climate	➢ Indigenous species are farmed locally ➢ An increased interest in indigenous mushrooms is generated ➢ Methods of fortifying mushrooms with nutrients are developed ➢ Reference material is available for taxonomic & systematic studies of local mushrooms ➢ New species of mushrooms are introduced for culture in Namibia	➢ Indigenous species respond to lab culturing techniques ➢ Indigenous knowledge of local mushrooms is shared

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
2.3 TECHNIQUES AND PRODUCTION SYSTEMS To develop small, medium and large scale facilities for mushroom production	MUS.TEC	▪ Appropriate designs of mushroom houses developed and tested ▪ Appropriate low cost substrate sterilization methods developed ▪ Mushroom production standards developed	➢ Carry out desk top study of various mushroom house designs ➢ Test low cost building methods ➢ Test environmental control of facilities ➢ Carry out production trials ➢ Test and standardize the production environment ➢ Assess of the impact of CO_2 and O_2 ratios in different types of fruiting rooms ➢ Evaluate substrate sterilization methods ➢ Evaluate optimal packaging of substrate ➢ Work with NSI to develop national mushroom production standards ➢ Determine economic viability of various production systems	➢ Community sets up mushroom facilities using locally available materials ➢ Cheap and efficient sterilization methods used by existing and new mushroom farmers	➢ Construction materials are available to test the designs

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3. COASTAL AGRICULTURE AND BIODIVERSITY **3.1 BIO SALINE AGRICULTURE** To identify and cultivate useful, salt tolerant plants	AGR.SAL	▪ Techniques developed for cultivation of bio- saline food crops and fodder species along the coast ▪ Techniques developed for irrigation of bio-saline crops ▪ Growth trials of saline tolerant crops completed ▪ Techniques developed to monitor soil condition ▪ EM technology used to investigate salt build-up in soil	➢ Obtain already patented plant material for testing ➢ Investigate indigenous saline tolerant plants ➢ Carry out Irrigation and growth trials to evaluate saline tolerant crops ➢ Monitor soil condition and develop techniques to avoid salt build-up ➢ Investigate the genetic modification of salt tolerant genes in plants ➢ Use effective micro-organism (EM) technology in determining the impact of salt build-up in plants/environment ➢ Investigate the effect of irrigation on salt build up in soils and plants	➢ Salt tolerant food crops and fodder species successfully grown at the coast ➢ Coastal agriculture becomes an important activity in Namibia	➢ Solutions to farming problems with salinity are found ➢ MAWF and NGOs support the initiative
3.2 BIODIVERSITY To identify and develop the cultivation of useful indigenous desert plants	AGR.BIO	▪ Collectable ornamental desert plants are identified ▪ Herbarium of desert plant collections expanded and database updated ▪ Propagation methods developed and tested ▪ Medicinal plants and uses identified	➢ Collect materials for the herbarium & update database ➢ Ethno-botanical survey of desert / coastal plants ➢ Test different propagation techniques for desert / coastal plants ➢ Monitor the effect of climate change on biodiversity in established permanent research quadrants ➢ Identify pharmacologically active ingredients in desert medicinal plants	➢ Increased utilization of indigenous desert & coastal flora ➢ Local and external researchers make use of the centre's herbarium and greenhouse facilities	➢ MET and NBRI support the initiative ➢ Other useful plants are identified and added to the herbarium

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
3.3 FORESTRY & DUNE STABILIZATION Identify and propagate plants that are fast growing and water efficient for desert greening and dune stabilization.	AGR.FOR	▪ Suitable species identified and collected ▪ Growth requirements, hardiness and water requirements tested ▪ Dune stabilization abilities of various species investigated ▪ Feasibility study for developing a desert farm completed	➢ Identify & select potential indigenous plants for windbreaks & dune stabilization ➢ Carry out growth trials and assess water use efficiency in selected plants ➢ Carry out large scale planting and monitor dune stabilization species ➢ Investigate the feasibility of developing a desert farm	➢ Identified plant species are used by towns and individuals as windbreaks and for dune stabilization ➢ Plant nurseries at the coast experience increased demand for the identified plant species ➢ Pilot scale desert farm initiated	➢ MET and NBRI support the initiative ➢ Other useful plants for dune stabilization exist and can be identified
3.4 HORTICULTURE To develop efficient techniques for the cultivation of high value plant species	AGR.HOR	▪ Different cultivation techniques for high value edible and decorative plant species investigated ▪ Economic viability of above technologies determined ▪ Potential crops and varieties identified and adapted	➢ Evaluate different hydroponics systems ➢ Promote peri-urban agriculture and evaluate its effects ➢ Investigate the effect of seaweed as a bio-fertilizer on soil and crop productivity ➢ Identify potential crops & varieties for adaptation to coastal conditions	➢ New horticultural products and techniques are readily available and affordable to majority of the people ➢ Production costs evaluated and published	➢ Market for locally produced horticultural products exists and quality is acceptable

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
4. RENEWABLE ENERGY **4.1 WIND ENERGY** To test and promote the use of wind energy	REN.WIN	▪ A dataset of wind conditions along the Namibian Coast available ▪ The development of a wind generator for local conditions ▪ Information available on the performance of wind generators under local conditions	➢ Collect wind data along Namibian coast ➢ Gather data available from Min. Fisheries & Marine Resources and Min. Mines & Energy ➢ Develop / customize a pilot wind power Generator, and install at appropriate locations ➢ Evaluate performance of wind generator, including economic viability ➢ Promote production of wind power generators in Namibia	➢ There is demand for wind energy among the coastal residents; ➢ Visible wind energy producing structures along the coast	➢ Centre has capacity to develop the technology ➢ Collaborating partners can be identified ➢ Suitable materials and designs are available

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
4.2 BIO-GAS To promote and produce the use of bio-gas from domestic waste	REN.GAS	▪ Various types of digesters constructed & materials tested ▪ Alternative resources of organic waste investigated ▪ Effectiveness of bio-digesters for sewerage treatment tested ▪ Uses of grey water tested ▪ Uses of sediment tested ▪ Scale of economics determined	➢ Build various types and sizes of bio-digesters from various materials ➢ Collect and test various locally available organic materials for production of bio-gas ➢ Investigate availability & sustainability of local materials ➢ Test the quality of the effluent water ➢ Test gas purification and safety measures ➢ Test uses of grey water (e.g. irrigation) ➢ Test uses of sediment from digesters ➢ Evaluate the economics of bio-gas, compared to other energy sources ➢ Promote, publish and demonstrate the use of bio-gas	➢ High demand for bio-gas digesters from local communities	➢ There is interest in bio-gas energy ➢ Support exists from Municipal Authorities ➢ No stigma exists among residents toward the use of use bio-gas energy.
4.3 WAVE ENERGY To promote wave or tidal energy as an alternative source of energy	REN.WAV	▪ Pilot wave energy plant established	➢ Complete research on monitoring wave height and variability at coastal stations ➢ Customize the technology to Namibian coastlines and establish a pilot plant	➢ Pilot plant generates interest among energy users & suppliers to exploit this possible renewable energy source, and are willing to finance scale up projects	➢ Centre has capacity to undertake technology development ➢ Partners can be identified

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
4.4 SOLAR ENERGY To promote development and use of solar energy for electricity generation and water heating	REN.SOL	➢ Publication documenting performance characteristics of various solar energy systems at the coast ➢ Various solar energy systems installed at the Centre ➢ Solar cell project initiated with Engineering Faculty	➢ Investigate performance of Photovoltaic Panels (PVP) for electricity generation and solar thermal collectors for water heating ➢ Install off-the-shelf photovoltaic panels ➢ Purchase and install various solar water collectors and study them ➢ Combined research on better / cheaper solar cells with Engineering Faculty	➢ Interest in solar energy and heating instilled in local communities ➢ Demonstration units operating at Centre ➢ Improved solar cell prototypes available	➢ Solar energy devices will perform satisfactorily under coastal conditions ➢ Partners can be found for solar cell project
5. WATER **5.1 DESALINATION** To develop cost effective desalination methods to be used for the production of fresh water for the Namibian coast.	WAT.DES	▪ The use of small solar stilts for production of portable water tested. ▪ Seawater greenhouse performance tested. ▪ The use of filter feeders as a pre-treatment tested and evaluated. ▪ Membrane use for freshwater production tested (reverse osmosis)	➢ Build solar distillation stilts ➢ Monitor water production under various conditions ➢ Monitor and evaluate water quality before and after filter feeders ➢ Investigate optimum arrangements of filtration by shellfish	➢ Interest among coastal towns towards desalination is rekindled ➢ NAMWATER becomes an important supporter and sponsor of projects.	➢ Centre has the capacity to develop and demonstrate the technology
5.2 HARVESTING To investigate and develop alternative freshwater sources at the coast.	WAT.HAR	▪ Durable and cost effective fog harvesters producing pure water developed ▪ Feasibility and cost effectiveness of harvesting freshwater using cold water condensation technology investigated	➢ Design and test various alternative fog harvesters ➢ Theoretical and desk study of the feasibility of cold water condensation ➢ Test various materials and surfaces for water collection ➢ Investigate factors influencing fog formation	➢ Coastal communities are exposed to novel source of water ➢ Factors influencing fog clearly understood	➢ Suitable materials are available for building harvesters ➢ Centre has capacity to develop technology

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
6. ENVIRONMENT **6.1 CLIMATE CHANGE** To monitor climate change and its effect in Namibia	ENV.CLI	▪ The development of a National Research Programme regarding Climate change and its effects in Namibia	➢ MRC to coordinate research programme between SANUMARC, Meteorological Institute, Geography Dept., Min. Environment & Tourism and Min. Fisheries & Marine Resources	➢ National research programme in place	➢ All participants willing to take part in programme
6.2 COASTAL MICRO-CLIMATE To monitor the climatic conditions around Henties Bay with an analysis of micro-climate variations	ENV.MIC	▪ Linking up with all MET offices on a continuous basis ▪ Long term detailed database of local climate initiated ▪ Various microclimates identified	➢ Monitor on a continuous basis all data from local weather stations ➢ Data analysis ➢ Deploy and monitor mobile weather stations ➢ Mapping of different micro climates	➢ Researchers and visitors have easy access to reliable weather reports of Henties Bay and its environs.	➢ Mobile weather instruments function properly

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6.3 CORROSION To study various ways of corrosion prevention along the Namibian Coast, including protective coatings	ENV.COR	▪ Mechanisms of corrosion documented ▪ Chemistry of fog & seawater understood ▪ Optimum coatings identified and tested for various surfaces ▪ Feed back of information to manufacturers of coatings	➢ Study corrosion mechanisms along the coast ➢ Carry out chemical analysis of seawater & fog ➢ Investigate corrosion prevention methods ➢ Investigate feasibility of implementing local authority by-laws to reinforce use of anti-corrosion coatings on buildings ➢ Invite coating companies and interested people to submit products for testing ➢ Obtain SABS standards and test data for various coatings ➢ Test various coatings	➢ Paint and coating manufacturers show willingness to enter into partnerships ➢ Coastal residents are eager to use identified coatings	➢ Research capacity exists within the Centre ➢ Partnerships are forthcoming ➢ Coating industry is supportive
6.4 GEOMORPHOLOGY To determine the changes in land coastal landscape over time and identify the causes	ENV.GEO	▪ The interaction and effects of landscape changes on human settlement identified	➢ Identify areas and processes of concern ➢ Monitor changes continuously ➢ Study effects of changes on settlement	➢ Demand for geomorphologic data increases among various stakeholders, including conservation planners	➢ Reliable transport is available most of the time; ➢ Geological maps are available to complement study

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7. COMMUNITY OUTREACH **7.1 HORTICULTURE** To develop various horticulture income generating projects for local communities with the view of coastal expansion of such activities	COM.HOR	▪ Sustainable, income -generating community-based horticulture projects supported ▪ New, high value crops in regular production ▪ Increased community income achieved	➢ Use Tulongeni Gardens as pilot / demonstration project for training purposes ➢ Promote better management and financial skills ➢ Carry out training on the cultivation of new high value crops ➢ Assist communities to explore markets ➢ Monitor soil condition and production	➢ More community members ask for training courses ➢ Strong interest in locally produced horticultural products ➢ More people are involved in production activities	➢ Markets are available and quality is assured
7.2 MUSHROOM To expand existing and develop new mushroom production projects for job creation	COM.MUS	▪ Economically viable mushroom businesses developed	➢ Provide training in mushroom production technologies ➢ Solicit funds for the expansion of mushroom cultivation in the communities ➢ Propagate spawn to supply producers ➢ Provide technical advice and extension services	➢ Increased demand for training courses ➢ Active mushroom farming cooperatives established ➢ Reduction in unemployment figures	➢ Markets for mushrooms are available and quality is assured ➢ Spawn availability is not a limiting factor ➢ Substrate availability is not limiting
7.3 BIO-GAS Promote bio-gas technology as an alternative source of energy	COM.GAS	▪ Active promotion of the production and use of bio-gas at all levels ▪ Identification of alternative sources of organic waste for bio-gas production.	➢ Initiate engineering study for the manufacture of large scale bio-digesters ➢ Test and evaluate locally available material for use in bio –digesters	➢ Many households show interest in bio-gas digesters ➢ Cleaner environment around households having bio- digesters	➢ Community accept bio-gas as clean renewable source of energy ➢ Cheaper materials are available for bio-gas digester construction

PROGRAMMES, PROJECT AND OBJECTIVES	CODE	EXPECTED OUTPUTS	ACTIVITIES	SUCCESS INDICATORS	ASSUMPTIONS
7.4 SEAWEED To promote the utilization of beach cast seaweed	COM.SEA	▪ Value added to beach cast seaweed.	➢ Collect beach cast seaweed ➢ Evaluate different species for different uses ➢ Monitor seasonal volumes of beach cast seaweed	➢ Cleaner beaches as beach cast seaweed is collected for value addition ➢ Communities adopt new technologies for value addition ➢ Different products derived from seaweeds are seen on the local market	➢ Seaweed value addition technologies are acquired and transferred to communities
7.5 SCIENCE AND TECHNOLOGY PROMOTION To stimulate an interest in science and technology in all Namibians, especially youth	COM.SAT	▪ The value of science and technology instilled in all visitors to the Centre ▪ Generate an interest in science & technology at local schools	➢ Promotion of science and technology to schools ➢ Participate in science and technology fairs ➢ Encourage and support competitions within and between schools ➢ Assist with the identification and support of school projects ➢ Provide basic laboratory training and facilities	➢ More youths show interest in science and technology subjects in schools after visiting the Centre ➢ There are requests received from schools and colleges to visit the Centre	➢ Teachers in schools continue to show interest in the activities at the Centre ➢ Outreach programmes at the centre reach beyond Henties Bay

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