SUPPLEMENTARY MATERIALS

Guidance for scenario narrative formation

To stimulate conversations amongst participants while defining the narratives underpinning the scenario options for these questions were suggested. However, these were a guide only.

Table S1. Guiding questions for scenario narrative formation in Pemba and Unguja multistakeholder workshops.

Pathway	Guiding questions
Improving the adaptive capacity of communities	● What are the biggest challenges facing local livelihoods today? ● How are people currently responding to those challenges? ● Are people's current response strategies adequate for dealing with change or not? ● What kind of training and education is needed to help people overcome these emerging challenges? ● Are there any specific areas in Zanzibar that need to prioritise? If so, explain why. ● Which sectors or organisations should be involved in providing education and training? ● Are there any barriers to people accessing education and training? ● How might these barriers be overcome?
Protection and regeneration of ecosystems – with consideration to areas of cultural and spiritual importance	● Which ecosystems are important to protect and why? ● Which types of ecosystems are important to regenerate and why? ● Why were these ecosystems degraded or removed before? ● Do communities rely on these types of ecosystem for their livelihoods? ● Are there external pressures which result in ecosystem degradation or removal? ● What kinds of natural places are of spiritual and cultural importance? ● Are there any areas that need to be highlighted as being of high priority for protection and regeneration? ● How should ecosystems and places of spiritual and cultural importance be protected and regenerated? ● Are there any barriers to successfully protecting ecosystems and places of

	spiritual and cultural importance? ● Can these barriers be overcome? If so how? ● Which sectors or groups should be involved in decision making about protecting and regenerating ecosystems and places of spiritual and cultural importance?
Sustainable settlement planning	● How do you think Zanzibar might develop between now and 2030? ● What will be the main economic focus of Zanzibar in the coming years? ● Which areas are most likely to change as a result of socio-economic development? ● How can communities in these areas be affected? What will be the positive and negative impacts? ● What role will settlement planning play in supporting sustainable land use? ● What specific interventions could be made to support more sustainable settlements? ● What specific interventions are needed to ensure that settlements are planned appropriately? ● As the country develops, are their opportunities for using green/renewable energy sources? ● Which areas are likely to become more urbanised? ● Will there be any resulting losses to environments as a result of urbanisation and if so how could such losses be minimised?

Land cover classes

The terms used on the right hand side were used in the multi stakeholder workshops to describe land use and land cover change. These do not directly coincide with the land classes in the *Copernicus* Global Land Service maps used in the modelling process. To align the land cover classes, the location of land cover types was compared with a land cover map developed by the Zanzibar's Department of Forestry, Renewable and Non-renewable Resources from 2012. Discussions were also held with other ecological researchers in Zanzibar for advice about how the terms used in the workshops might correspond to the land cover data. One of the most difficult categories to identify within the *Copernicus* Global Land Service land cover maps was mangroves. The most up to date world land cover map by ESA worldcover includes a mangrove layer for 2020. As there is only a layer for 2020 and not another time step it is not possible to use this more detailed map in the Land Change Modeler analysis. However, by comparing the 2019 map and 2020 map we can see that mangrove forests appear to be encompassed within the 'unknown forest closed' and

'unknown forest open' land categories in specific locations. This also corresponds well with the transitions identified in the land change analysis outputs which show that unknown forest (open and closed) transitioned to wetland vegetation, assuming that deforestation of mangroves resulted in increased wetland vegetation.

Table S2. Land cover class descriptions used in initial modelling process (note these were later simplified further).

Land class	**Description**	**Corresponding land cover classes from workshops**
Shrubland	These are woody perennial plants with persistent and woody stems and without any defined main stem being less than 5 m tall. The shrub foliage can be either evergreen or deciduous.	Native bushland (degraded coral rag forest, but with regeneration/restoration potential)
Herbaceous vegetation	Plants without persistent stem or shoots above ground and lacking definite firm structure. Tree and shrub cover is less than 10 %.	Thin woody vegetation
Cropland	Lands covered with temporary crops followed by harvest and a bare soil period (e.g, single and multiple cropping systems). Note that perennial woody crops will be classified as the appropriate forest or shrub land cover type.	Mixed farming and commercial farming
Built up	Buildings and other manmade structures.	Built up
Bare or sparse vegetation	Lands with exposed soil, sand, or rocks and never has more than 10 % vegetated cover during any time of the year.	Bare land
Permanent waterbodies	Lakes, reservoirs, and rivers. Can be either fresh or salt-water bodies.	-
Herbaceous wetland	Lands with a permanent mixture of water and herbaceous or woody vegetation. The vegetation can be present in either salt, brackish, or fresh water.	-
Evergreen broadleaved forest (closed)	Tree canopy >70 %, almost all broadleaf trees remain green year round. Canopy is never without green foliage.	Coral rag forest
Deciduous broadleaved forest (closed)	Tree canopy >70 %, consists of seasonal broadleaf tree communities with an annual cycle of leaf-on and leaf-off periods.	Plantation forest
Unknown forest (closed)	Closed forest, not matching any of the other definitions	Coral rag and other natural forest, in close proximity to the sea this includes mangrove
Evergreen broadleaved	Top layer- trees 15-70 % and second layer mixed of shrubs and grassland, almost all broadleaf trees remain green year round.	Coral rag forest

forest (open)	Canopy is never without green foliage.	
Deciduous broadleaved forest (open)	Top layer- trees 15-70 % and second layer mixed of shrubs and grassland, consists of seasonal broadleaf tree communities with an annual cycle of leaf-on and leaf-off periods	Plantation forest
Unknown forest (open)	Open forest, not matching any of the other definitions	Coral rag and other natural forest, in close proximity to the sea this includes mangrove
Sea	Oceans, seas. Can be either fresh or salt-water bodies.	-

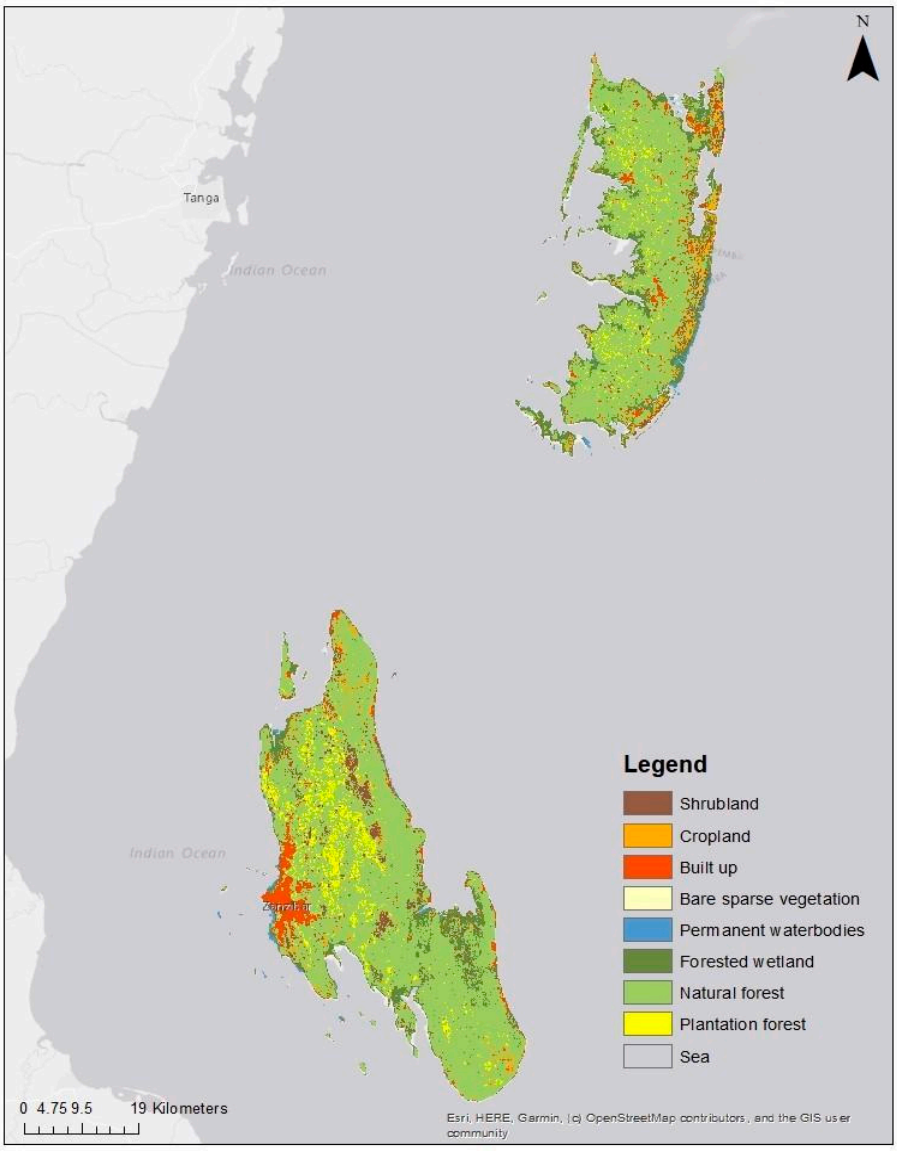


Figure S1. Map of Unguja and Pemba islands and land use and land cover for the year 2019 (when fieldwork was conducted). Land cover calculated using *Copernicus* Global Land Cover data (Buchman et al, 2020), which was modified to encompass scaled knowledge of the local area.

Data sources

Table S3. The data sources for variable land cover modelling.

Layer	Resolution	File type	Reference	Website
Land cover 2015	100 m	Tiff	Buchhorn, M.; Smets, B.; Bertels, L.; Lesiv, M.; Tsendbazar, N.-E.; Masiliunas, D.; Linlin, L.; Herold, M.; Fritz, S. (2020). Copernicus Global Land Service: Land Cover 100m: Collection 3: epoch <YEAR>: Globe (Version V3.0.1) [Data set]. Zenodo. DOI: https://doi.org/10.5281/zenodo.3939038	*https://lcviewer.vito.be/about*
Land cover 2019	100 m	Tiff	Buchhorn, M.; Smets, B.; Bertels, L.; Lesiv, M.; Tsendbazar, N.-E.; Masiliunas, D.; Linlin, L.; Herold, M.; Fritz, S. (2020). Copernicus Global Land Service: Land Cover 100m: Collection 3: epoch <YEAR>: Globe (Version V3.0.1) [Data set]. Zenodo. DOI: https://doi.org/10.5281/zenodo.3939050	*https://lcviewer.vito.be/about*
Elevation	10km	Tiff		*https://asterweb.jpl.nasa.gov/GDEM.asp*
Roads	-	Shp/vector	Center for International Earth Science Information Network - CIESIN - Columbia University, and Information Technology Outreach Services - ITOS - University of Georgia. 2013. Global Roads Open Access Data Set, Version 1 (gROADSv1). Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4VD6WCT. Accessed DAY MONTH YEAR.	*https://sedac.ciesin.columbia.edu/data/set/groads-global-roads-open-access-v1/data-download#close*
Soil composition	-	Polygon	Panagos, P, Van Liedekerke, M, Borrelli, P, Köninger, J, Ballabio, C, Orgiazzi, A, Lugato, E, Liakos, L, Hervas, J, Jones, A. Montanarella, L. 2022. European Soil Data Centre 2.0: Soil data and knowledge in support of the	https://esdac.jrc.ec.europa.eu/content/soil-map-soil-atlas-africa

			EU policies. European Journal of Soil Science, 73(6), e13315. DOI: 10.1111/ejss.1331	

Sub model compositions for explaining land cover change between 2015 and 2019

Sub models were created to help explain each of the broad land cover transitions identified.

Table S4. Sub model details for transition potential maps explaining land cover change between 2015 and 2017 in Unguja.

Sub model	Transitions	Minimum number of cells	Spatial variables in minimum model sub model structure	Accuracy percentage	Skill score
Sea level	Herbaceous vegetation to herbaceous wetland	428	Slope, soil composition	68.85	0.3570
Water body reduction (mangrove)	Permanent waterbody to herbaceous wetland	251	Slope, distance from roads, distance from protected areas, DEM, distance from wetlands, likelihood of change	71.31	0.462
Deforestation (mature forest)	Unknown closed forest to herbaceous wetland, unknown open forest to herbaceous wetland	870	Slope, likelihood of change	74.51	0.6602
Deforestation (Shrubland)	Shrubland to herbaceous wetland	611	Slope, distance from built up, distance from sea, distance from protected areas, soil composition, likelihood of change	78.07%	0.5613

Table S5. Sub model details for transition potential maps explaining land cover change between 2015 and 2017 in Pemba.

Sub model	Transitions	Minimum number of cells	Spatial variables in minimum model sub model structure	Accuracy percentage	Skill score
Sea level	Herbaceous vegetation to	511	DEM, distance from roads, distance from	73.22	0.4645

	herbaceous wetland		closed forest, distance from sea, soil composition		
Water body reduction (mangrove)	Permanent waterbody to herbaceous wetland	463	DEM, distance from closed forest, soil composition	61.04	0.2208
Deforestation (mature forest)	Unknown closed forest to herbaceous wetland, unknown open forest to herbaceous wetland	904	Distance from wetlands, distance from settlements, distance from sea, soil composition and likelihood of change	60.50	0.4734

Calculations for land demand for the business as usual scenarios

To include expansion of built-up areas in the alternative scenario maps, the difference area between 2015 and 2019 for the built-up category was calculated using the known land cover data sets from *Corpencious*. The difference was calculated as a factor for the annual rate of change and the following calculation was then conducted to determine the total area demand for built up land in 2030 :

$$Annual\ rate\ of\ change = \frac{Difference\ in\ area\ between\ 2015\ and\ 2019}{Average\ area\ respective\ of\ 2015\ and\ 2019}$$

Table S6. Area of built up land cover class

Year	**Built up area Pemba (ha)**	**Built up area Unguja (ha)**
2015 (actual)	0.830265	2.243410
2019 (actual)	0.833215	2.253717
2030 (bau model)	0.833215	2.253717

Calculation for annual rate of area change for the built up land class in Pemba (ha):

$$Annual\ rate\ of\ change = \frac{0.833 - 0.830}{(0.830 + 0.833)/2}$$

$$Annual\ rate\ of\ change = 0.004$$

Calculation for annual rate of area change for the built up land class in Unguja (ha):

$$Annual\ rate\ of\ change = \frac{2.254 - 2.243}{(2.243 + 2.254)/2}$$

$$Annual\ rate\ of\ change = 0.005$$

Demand for built up land area calculation:

$$Future\ surface\ = present\ surface\ \times\ [1 + Annual\ rate\ of\ change] \wedge number\ of\ years$$

Calculation for built up land class demand for 2030 in Pemba (ha):

$$Future\ surface = \ 0.833\ \times (1 + 0.004)\text{^}11$$

$$Future\ surface = \ 0.871$$

Calculation for built up land class demand for 2030 in Unguja (ha):

$$Future\ surface = \ 2.253717 \times (1 + 0.005)\text{^}11$$

$$Future\ surface = \ 2.381$$

Increase in land demand for built up class from current bau model for Pemba (ha):

$$Additional\ land\ demand = \ 0.871 - 0.833$$

$Additional\ land\ demand = 0.037$

Increase in land demand for built up class from current bau model for Unguja (ha):

$Additional\ land\ demand = 2.381 - 2.254$

$$Additional\ land\ demand = \ 0.127$$

Note that for the spatial decision modeller, the demand allocation needs to be in pixels. In Pemba 1 ha was equal to 2712.39 cells, the additional land demand 100 cells (as an integer). In Unguja 1 ha was equal to 2716.85 cells so the additional land demand was equal to 345 cells (as an integer).

Using the reclass function in TerrSet, Boolean constraint maps were created to ensure that potential land transitions to the built up class would not occur in existing built up areas, sea, permanent water bodies, wetlands or protected areas. Decision variables including distance from built-up, distance from sea, distance from settlements, distance from roads and slope were then converted into factors with a likelihood scale of 0-1 using the fuzzy module. A suitability image for land cover transition was created using multi-criteria analysis. The allocation of land according to the specified demand was then calculated using the multiple land allocation tool (MOLA). Using MOLA it is possible to specify contiguity and compactness, however as all sampled villages indicated expected settlement expansion this criteria was not selected for in this case. The modelled business as usual (BAU) land cover maps and the spatial allocation maps for additional build up areas were then brought into ArcMap 10.8.1. Using the conditional evaluation tool, the pixels for additional built up areas from the spatial allocation map were applied to the modelled BAU land cover maps. This increased the built up land allocation from 0.833 ha to 0.871 ha in Pemba and 2.254 ha to 2.831 ha in Unguja for the 2030 BAU scenario.

Decisions about the shape of the function and its control points were based on observations of where current built up locations are on the 2019 land cover maps for Pemba and Unguja.

The main observed difference between the islands was that in Pemba settlements are more frequently found inland and in Unguja these are more concentrated at the coast. The following assumptions were made that expansion of built up areas (in Unguja especially) would be more concentrated on the coast, close to existing settlements, close to existing road infrastructure and on lower sloped areas.

Model conditions for creating the land cover scenario maps for the three alternative options

For constraint maps *Copernicus* Global Land Service layers were used, these were converted into Boolean maps in IDRISI using the function Reclass to give all land cover types where change could occur a value of 1 and land cover types where change could not occur a value of 0.

Some groups discussing land cover transitions specified specific ward (or Shehia) areas where change would be more likely to occur. To convert this information into spatial data used a Tanzania ward layer in ArcMap 10.8.1, I clicked on editing and start editing to select the specific ward area. I then went to the menu at the top and in the dropdown menu for "geoprocessing" I selected "clip". I then had to alter the extent of the clipped layer to coincide with previously used spatial variables. To do this I opened Arc Catalogue and right clicked on the new clipped layer and in the properties pop out box was able to alter the feature extent manually. Once the extent matched that of the other spatial variables, I was able to use Euclidean Distance to calculate distance from ward. These raster layers were saved as ASCII files to be reconverted into raster's in IDRISI.

In addition to the variables specified within the multistakeholder workshops we also added other variables which had been indicated in the initial scoping study (see Newman et al, 2023a) and community level workshops (see Newman et al, 2023b). Where possible specific spatial parameters from wider literature were also used.

Pemba scenario 1 adaptation

The adaptation scenario details for Pemba island are detailed below, specifying the transitions and conditions where these transitions are most likely.

Table S7. Modelling conditions for the adaptive capacity scenario in Pemba. Likelihood of land transition ranges from 1 (least likely) to 4 (most likely). Relationship of the influencing variables to the pattern of transition described as monotonically increasing (the further away from the variable the more likely the transition), monotonically decreasing (the further away the variable is the less likely the transition).

Land class increase in demand (ha)	**Take from land classes (likelihood 0-4)**	**Constraint map components**	**Variables influencing transition according to stakeholders**	**Variables influencing transition according to literature**
Built up 0.019	Cropland - 3	Built up, bare sparse vegetation, permanent waterbodies, herbaceous	Distance from Vitongoni for	Distance from sea, distance

	Shrubland - 3 Herbaceous vegetation - 2 Unknown forest (closed) - 4 Unknown forest (open) - 4	wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), sea	losses of unknown forest, distance from Mbuzini for losses in shrubland	from roads, distance from existing settlements, slope
Bare sparse vegetation 0.003	Deciduous forest (closed) - 3 Deciduous forest (open) - 3	Shrubland, herbaceous vegetation, cropland, built up, bare sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), unknown forest (closed), evergreen broadleaved forest (open), unknown forest (open), sea	-	Distance from settlements, distance from roads, distance from evergreen forests, distance from unknown forests, distance from shrubland, slope
Cropland 0.178	Evergreen forest (closed) - 2 Evergreen forest (open) - 2 Unknown forest (closed) - 2 Unknown forest (open) - 2	Shrubland, herbaceous vegetation, cropland, built up, bare sparse vegetation, permanent waterbodies, herbaceous wetland, deciduous broadleaved forest (closed), deciduous broadleaved forest (open), sea	Distance from Pujini	Distance from existing cropland, distance from permanent waterbodies, distance from settlements, distance from roads, slope
Shrubland 0.023	Evergreen forest (open) - 2 Unknown forest (open) - 2 Cropland - 2	Shrubland, herbaceous vegetation, built up, bare sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed), deciduous broadleaved forest (open), sea	Distance from Ngezi forest	Distance from settlements, distance from roads, distance from unknown forests, slope

Using these conditions, the following a map was produced, however this did not represent some the broader transitions represented in the 2030 prediction produced using the Land Change Modeller Analysis which largely demonstrated transitions to herbaceous wetland.

To improve the potential accuracy of the model these transitions were applied to the alternative scenario maps.

To improve to accuracy of the model the transition to herbaceous wetland from the Land Change Modeler process was also added to the scenario. The variables influencing the transition were taken from the sub models detailed in SM3, these included from wetland vegetation, permanent waterbodies and unknown forests. Most of the changes occurred in the CMfl soils, in the transition from unknown forest to herbaceous wetland a constraint map was used to limit changes to areas with this soil type. It was not possible to apply the soil constraint map to the permanent water and herbaceous vegetation transitions to wetland and these parcels of land predominantly lied outside of this type of soil composition. Instead of using the total area of change for this transition outlined in the BAU scenario a more conservative estimate was applied using the minimum expected number of cells per transition as a guide.

Unguja scenario 1 adaptation

The adaptation scenario details for Unguja island are detailed below, specifying the transitions and conditions where these transitions are most likely.

Table S8. Modelling conditions for the adaptive capacity scenario in Unguja. Likelihood of land transition ranges from 1 (least likely) to 4 (most likely). Relationship of the influencing variables to the pattern of transition described as monotonically increasing (the further away from the variable the more likely the transition), monotonically decreasing (the further away the variable is the less likely the transition).

Land class increase in demand (ha)	**Take from land classes (likelihood 0-4)**	**Constraint map components**	**Variables influencing transition according to stakeholders**	**Additional variables influencing transition according to literature**
Built up 0.0254	Cropland - 1 Unknown forest (closed) - 3	Shrubland, herbaceous vegetation, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea	Distance from existing built up areas, distance from sea	Distance from roads, slope
Evergreen forest (closed) 0.46557	Shrubland - 2	Cropland, built up, herbaceous vegetation, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen	-	Distance from built up, distance from roads, slope

		broadleaved forest (closed), deciduous broadleaved forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea		
Cropland 0.0064	Evergreen forest (closed) - 1 Deciduous forest (closed) - 3	Shrubland, cropland, built up, herbaceous vegetation, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea	-	Distance from existing cropland, distance from evergreen forest (closed), distance from deciduous forest (closed), distance from built up, distance from roads, slope
Shrubland 0.02173	Unknown forest (closed) - 1 Herbaceous vegetation - 2	Shrubland, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea	Distance from community managed forests (layer used – distance from built up)	Distance from existing cropland, distance from unknown forest (closed), distance from herbaceous vegetation, distance from roads, slope

Pemba scenario 2 ecosystem management

The ecosystem management scenario details for Pemba island are detailed below, specifying the transitions and conditions where these transitions are most likely.

Table S9. Modelling conditions for the ecosystem management scenario for Pemba. Likelihood of land transition ranges from 1 (least likely) to 4 (most likely). Relationship of the influencing variables to the pattern of transition described as monotonically increasing (the further away from the variable the more likely the transition), monotonically decreasing (the further away the variable is the less likely the transition).

Land class increase in demand (ha)	**Take from land classes (likelihood 0-4)**	**Constraint map components**	**Variables influencing transition according to**	**Variables influencing transition according to**

			stakeholders	**literature**
Built up 0.0074	Deciduous open forest - 2 Herbaceous vegetation -1	Shrubland, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown Forest (closed) evergreen broadleaved forest (open), unknown Forest (open) Sea	High population increase (use distance from settlements)	Distance from roads, slope, distance from sea
Cropland 0.4095	Shrubland - 1 Deciduous open forest - 3	herbaceous vegetation, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed), evergreen broadleaved forest (open), unknown forest (open), sea	Proximity to Pujini	Distance from existing cropland, distance from evergreen forest, distance from closed forest, distance from built up, distance from roads, slope
Unknown forest closed 0.0938	Shrubland - 1	Herbaceous vegetation, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), Sea	-	Distance from built up, distance from roads, slope

Unguja scenario 2 ecosystem management

The ecosystem management scenario details for Unguja island are detailed below, specifying the transitions and conditions where these transitions are most likely.

Table S10. Modelling conditions for the ecosystem management scenario in Unguja. Likelihood of land transition ranges from 1 (least likely) to 4 (most likely). Relationship of the influencing variables to the pattern of transition described as monotonically increasing (the further away from the variable the more likely the transition), monotonically decreasing (the further away the variable is the less likely the transition).

Land class increase in demand (ha)	Take from land classes (likelihood 0-4)	Constraint map components	Variables influencing transition according to stakeholders	Variables influencing transition according to literature
Built up 0.03348	Cropland - 1 Unknown forest (open) - 2 Herbaceous vegetation - 2	Shrubland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), sea	Close proximity to Muyuni (use Kigomani as understand they refer to Muyuni beach and on the county map Muyuni shows as a different district), Paje and Kiwengwa	Distance from roads, slope, distance from sea
Bare sparse vegetation 0.0019	Unknown forest closed - 1	Shrubland, herbaceous vegetation, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, Evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea	-	Distance from settlements, distance from roads, distance from evergreen forests, distance from unknown forests, distance from shrubland, slope
Unknown 0.092	Cropland - 4	Shrubland, herbaceous vegetation, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea	-	Distance from existing cropland, distance from built up, distance from roads, slope
Deciduous	Shrubland - 2	Herbaceous vegetation, Cropland,	Close	Distance from

forest (open) 0.099		built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea	proximity to Pongwe	built up, distance from roads, distance from deciduous forest

Pemba scenario 3 - settlement planning

The settlement planning scenario details for Pemba island are detailed below, specifying the transitions and conditions where these transitions are most likely.

Table S11. Modelling conditions for the settlement planning scenario in Pemba. Likelihood of land transition ranges from 1 (least likely) to 4 (most likely). Relationship of the influencing variables to the pattern of transition described as monotonically increasing (the further away from the variable the more likely the transition), monotonically decreasing (the further away the variable is the less likely the transition).

Land class increase in demand (ha)	**Take from land classes (likelihood 0-4)**	**Constraint map components**	**Variables influencing transition according to stakeholders**	**Variables influencing transition according to literature**
Deciduous forest 0.3302	Evergreen forest -2	Shrubland, herbaceous vegetation, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, deciduous broadleaved forest (closed), unknown forest (closed), deciduous broadleaved forest (open), unknown forest (open), sea	Close to built up areas, close to existing forest (closed)	Distance from roads, slope
Bare sparse vegetation 0.137	Herbaceous vegetation - 3	Shrubland, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed) evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest	-	Distance from built up, distance from roads, distance from forests (closed)

		(open), sea		
Herbaceous wetland 2.256	Unknown forest - 2	Shrubland, herbaceous vegetation, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), evergreen broadleaved forest (open), deciduous broadleaved forest (open), sea	Low slope close to the sea	Distance from built up, distance from roads

For this scenario the prediction for transition 3 was that some land would be lost to sea. Instead of doing a direct loss of land to sea a transition was instead made to wetland as this appeared to be the prediction associated with sea level rise from the BAU scenario. Because in the prediction the percentage of land loss to the sea was not calculated the number of pixels associated with the wetland transition in the earlier BAU model was taken and used to model this transition.

As a transition to wetland was modelled at this stage the additional wetland transition was not needed.

Unguja scenario 3 settlement planning

The settlement planning scenario details for Unguja island are detailed below, specifying the transitions and conditions where these transitions are most likely.

Table S12. Modelling conditions for the settlement planning scenario in Unguja. Likelihood of land transition ranges from 1 (least likely) to 4 (most likely). Relationship of the influencing variables to the pattern of transition described as monotonically increasing (the further away from the variable the more likely the transition), monotonically decreasing (the further away the variable is the less likely the transition).

Land class increase in demand (ha)	**Take from land classes (likelihood 0-4)**	**Constraint map components**	**Variables influencing transition according to stakeholders**	**Variables influencing transition according to literature**
Built up 0.024	Cropland - 3 Unknown forest - 3	Shrubland, herbaceous vegetation, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, Evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), evergreen broadleaved forest (open), deciduous broadleaved	Areas close to built up areas, areas close to roads, distance from Ukongoroni, on Tambatu	Distance from cropland, distance from unknown forest, slope

		forest (open), sea	island	
Bare sparse vegetation 0.0015	Shrubland - 2	Herbaceous vegetation, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, Evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed) evergreen broadleaved forest (open), deciduous broadleaved forest (open), unknown forest (open), sea	Distance from Kiwengwa	Distance from built up, distance from roads, distance from existing shrubland, slope
Shrubland 0.1572	Deciduous forest (open) - 3 Evergreen forest (open) - 3	Shrubland, herbaceous vegetation, cropland, built up, bare or sparse vegetation, permanent waterbodies, herbaceous wetland, Evergreen broadleaved forest (closed), deciduous broadleaved forest (closed), unknown forest (closed), unknown forest (open), sea	Distance from Mtule	Distance from built up, distance from roads, distance from existing shrubland, slope

Results full land cover classes before simplification

The percentage of land cover change for each class was calculated using the full class list and is detailed below.

Table S13. Percentage differences in land cover area between the present day actual land cover and the predicted values for the BAU scenario for 2030 in Pemba.

	Area 2019 (ha)	**Area 2030 BAU (ha)**	**Difference 2019 and BAU (%)**	**Area 2030 S1 (ha)**	**Difference 2019 and S1 (%)**	**Area 2030 S2 (ha)**	**Difference 2019 and S2 (ha)**	**Area 2030 S3 (ha)**	**Difference 2019 and S3 (%)**
Shrubland	0.524	0.563	3.59	0.546	4.19	0.131	-60.12	0.524	0.03
Herbaceous vegetation	1.195	0.585	-34.27	1.006	-17.2	0.976	-10.07	1.058	-6.08
Cropland	1.365	1.72	11.51	1.534	11.69	1.775	13.05	1.365	0.01
Built up	0.833	0.87	2.16	0.851	2.17	0.841	0.45	0.833	0.01
Bare or	0.003	0.006	39.12	0.006	59.32	0.003	-7.51	0.140	95.80

sparse vegetation									
Permanent waterbodies	0.4	0.033	-84.85	0.23	-54.11	0.23	-27.06	0.400	0.04
Herbaceous wetland	4.755	8.919	30.45	5.448	13.58	5.448	6.79	5.448	6.79
Evergreen broadleaved forest (closed)	0.601	0.601	-0.03	0.6	-0.12	0.601	0	0.272	-37.61
Deciduous broadleaved forest (closed)	0.978	0.975	-0.15	0.975	-0.29	0.978	-0.01	1.308	14.44
Unknown forest (closed)	7.394	5.518	-14.53	7.214	-2.46	7.3	-0.64	7.165	-1.58
Evergreen broadleaved forest (open)	0.003	0.003	0	0.003	-1.715	0.003	-0.86	0.001	-46.13
Deciduous broadleaved forest (open)	0.038	0.038	0	0.037	-2.04	0.014	-47.18	0.038	-0.53
Unknown forest (open)	13.465	11.704	-6.99	13.104	-2.72	13.257	-0.78	13.002	-1.75
Sea	66.069	66.595	0.4	66.069	0	66.069	0	66.069	0.00
No data	0.524	0.563	7.18	0.506	-0.53	0.506	-1.77	0.506	-1.75

Table S14. Percentage differences in land cover area between the present day actual land cover and the predicted values for the BAU scenario for 2030 in Unguja.

	Area 2019 (ha)	Area 2030 BAU (ha)	Difference 2019 and BAU (%)	Area 2030 S1 (ha)	Percentage difference 2019 and S1	Area 2030 S2 (ha)	Difference 2019 and S2	Area 2030 S3 (ha)	Difference 2019 and S3
Shrubland	1.074	0.335	-52.43	0.722	-39.22	0.689	-21.87	0.831	-12.75
Herbaceous vegetation	1.439	1.434	-0.17	1.322	-8.46	1.165	-10.53	1.175	-10.12
Cropland	1.116	1.113	-0.15	1.033	-7.7	0.986	-6.18	1.029	-4.06
Built up	2.254	2.381	2.74	2.358	4.5	2.370	2.51	2.368	2.46
Bare or sparse vegetation	0.038	0.038	0	0.022	-51.43	0.024	-22.11	0.024	-23.46
Permanent waterbodies	0.364	0.083	-62.97	0.33	-9.75	0.237	-21.09	0.238	-20.98
Herbaceous wetland	3.462	8.443	41.84	4.22	19.72	5.027	18.44	5.049	18.64
Evergreen broadleaved forest (closed)	0.516	0.514	-0.18	0.816	45.09	0.515	-0.12	0.516	0.00
Deciduous broadleaved forest (closed)	3.097	3.085	-0.18	3.089	-0.24	3.087	-0.16	3.095	-0.04
Unknown forest (closed)	19.12	16.997	-5.88	18.706	-2.19	18.773	-0.91	18.722	-1.05
Deciduous broadleaved forest (open)	0.099	0.098	-0.19	0.099	-0.35	0.155	22.04	0.007	-87.45
Unknown forest (open)	16.704	14.761	-6.17	16.245	-2.79	16.140	-1.72	16.231	-1.44
No data	0	0	0	0.32	NA	0	0	0	NA

Consolidation of land classes

Because the transitions in some cases were small, and the fact that results are based on subjective qualitative descriptions, it was felt that overly detailed land cover classes might suggest more accurate knowledge on transitions than is presented. To really understand how land cover transitions might broadly impact land cover types which support water-energy-food security it is more useful to look at some of the potential broader transitions. For that reason, the land cover classes were consolidated. Please see below:

Table S15. Details of land cover consolidation for final map images and calculations.

New class	**Old class**
Shrubland	Shrubland, Herbaceous wetland
Cropland	Cropland
Built up	Built up
Bare sparse vegetation	Bare sparse vegetation
Permanent waterbodies	Permanent waterbodies
Forested wetland	Herbaceous vegetation
Natural forests	Evergreen forests (open and closed) Unknown forests (open and closed)
Plantation forest	Deciduous forests (open and closed)
Sea	Sea

Timeline photos

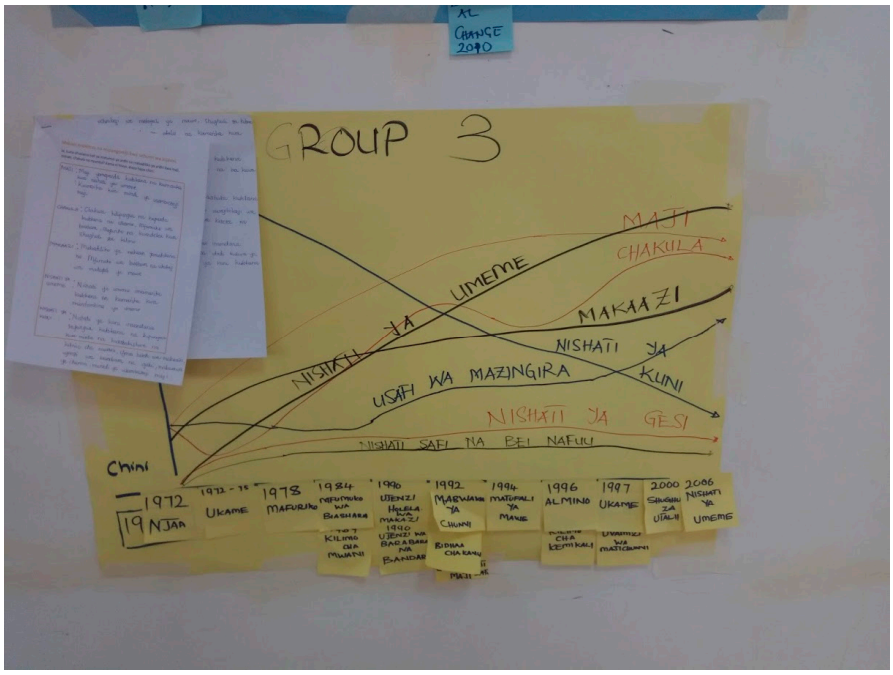


Figure S2. Pemba.

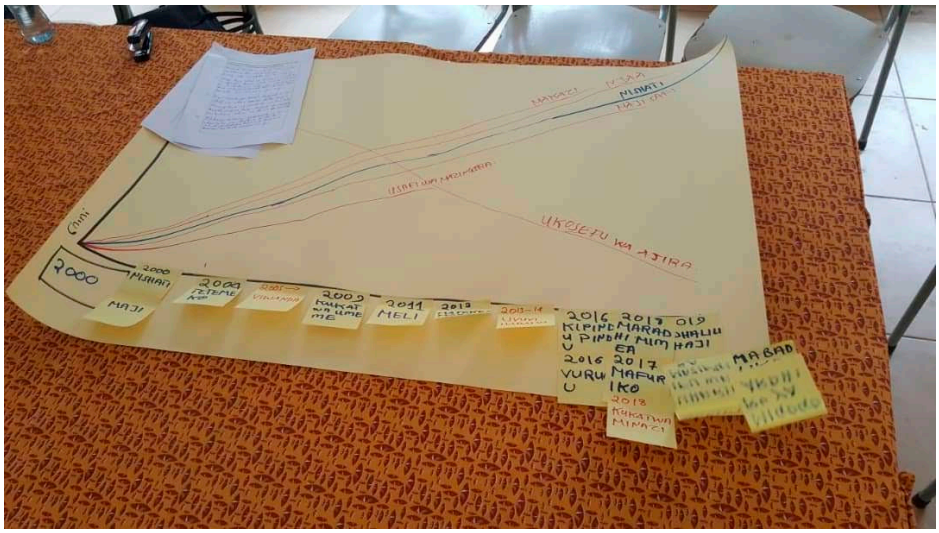


Figure S3. Unguja.